



SCIENCE

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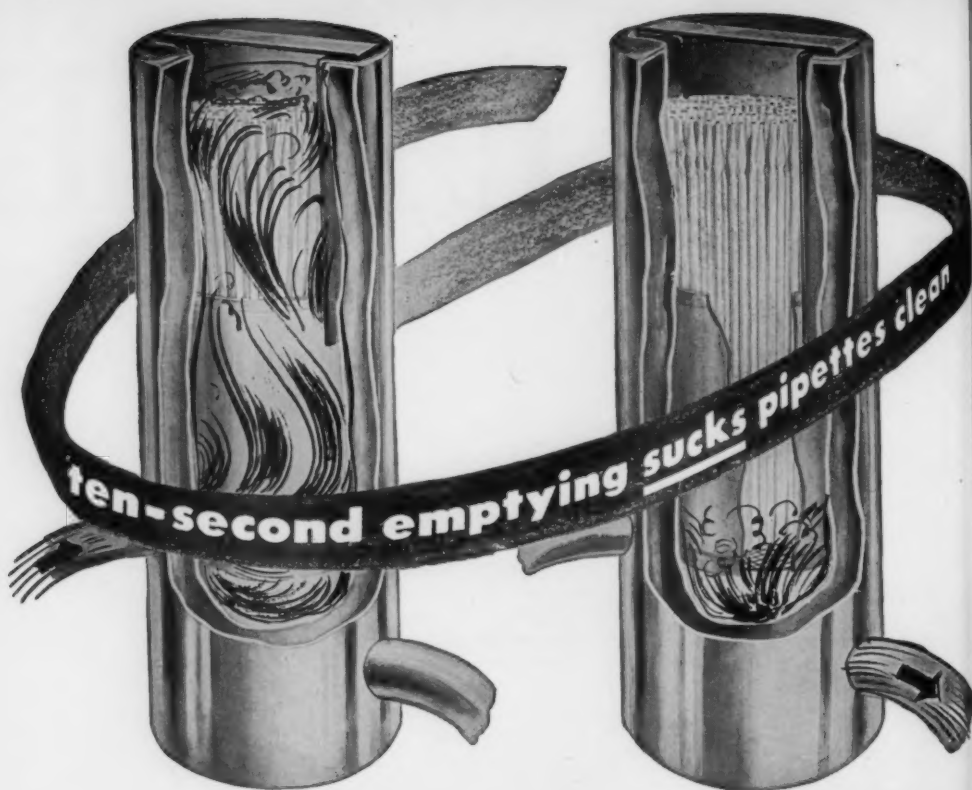
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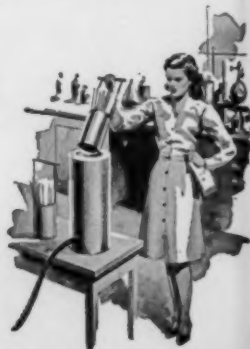
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Applied Anthropological Research

THE future historian of cultural anthropology may well consider the most significant development during the current decade to be the maturing of applied research. This trend emerged after World War I and changed anthropology from one of the least "practical" of the disciplines to one that may become of fundamental importance.

In the U. S. the first major impetus toward applied anthropological research came from the Indian Service in much the same way that in France, England, and Holland it came from colonial offices. The founding of the Society for Applied Anthropology in the 1930s saw extension of interest into industrial and organizational problems of our own society. The utility of anthropologically trained personnel also became obvious during World War II.

Following the war, interest in improving the technical and economic positions of underdeveloped countries crystallized in the Point IV program. Thinking administrators soon realized that neither institutions nor technologies can be exported successfully without adaptation to national and regional cultures. Local work habits, prejudices, and institutions present obvious obstacles, but even more resistances lie in differing goals and value systems. New agricultural techniques require ingenious adaptations in areas where traditional methods have religious or social sanctions. Public health measures may fail miserably in the face of stubbornly held disease concepts that do not recognize microorganisms.

Still greater difficulties are posed by the integrated character of cultural and social systems. Even where resistance is least to a basic technological change in such a field as agriculture, the introduction of new techniques inevitably leads to social conflicts. Some segment of the society affected feels endangered by change and will become hostile. It is important to recognize that any of our technical and economic aid programs will provoke the enmity of some group within the country affected, and we must evaluate

which elements we are willing to antagonize. Fortunately much constructive thinking is going on regarding this problem. Ambassador Capus Waynick, first (acting) administrator of the TEC, saw clearly that the major problem is not the transmittal of technical and economic aid, but how to do the job without making people angrier with us than they were before.

The two most important developments directed toward this problem are perhaps the pioneer program initiated at Cornell and the Coordinated Investigations in Micronesian Anthropology. The first involves modifying technical instruction to aid foreign students to interpret their new knowledge in terms applicable to their own cultures. In addition, it is investigating the repercussions in cultures affected by the introduction of technical innovations. The second program, sponsored by the Navy, showed ways in which research with basic and applied significance could be done under government sponsorship. As an aftermath, anthropologists are now attached to administrative staffs in Micronesia.

With the announcement of the Point IV program, the American Anthropological Association endorsed and supported the policy. Basic research must continue, for it forms the necessary prerequisite to successful application. Applied situations afford excellent proving grounds for the theoretical and conceptual structures deriving from basic investigation. In a field where the comparative method long offered the only substitute for laboratory testing of theory, new opportunities in applied research will help expand basic knowledge.

The dichotomy between applied and basic research will no doubt continue, but courses with applied interests are multiplying rapidly in universities, and research projects relating to the impact of industrialism on unmechanized cultures exist or are being formulated in practically every research center.

RALPH L. BEALS

University of California at Los Angeles

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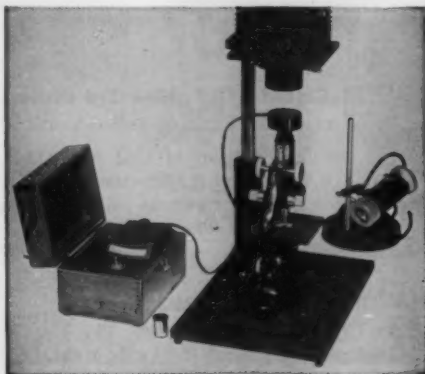
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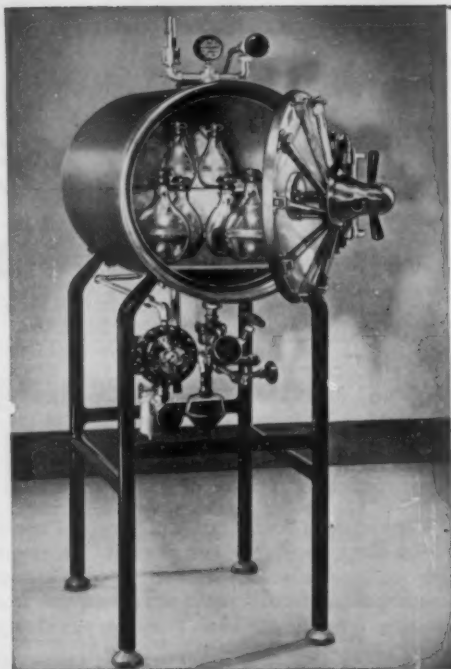
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Considerations on Utilization of Scientific Literature

Paul Alfred Woke

*Laboratory of Tropical Diseases, Microbiological Institute,
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THE ACCUMULATING BODY OF KNOWLEDGE in the scientific literature constitutes an essential factual basis for continued research and for human understanding and progress. The availability of the literature in forms best suited for utilization is thus highly important.

Present arrangements, however, fall far short of providing the literature in such a way that it can be most efficiently used, and the rapidly increasing output and complexities of science necessitate ever greater economy of effort, if the scientist is to keep informed in expanding fields. Moreover, as a consequence of the vastly greater output of information anticipated for the decades immediately ahead, conditions may arise which could not only limit the possibilities for adequate publication and utilization, but also stifle deliberation on possible solutions to the problem. Circumstances might lead to the setting up of arbitrary and undesirable practices; consequently, the need to consider possible changes in the means employed by the scientific information services is immediate. The solution of the problem lies, not in simple modification of conventional means, but in a broader approach. The situation may be most advantageously met if scientists accept the responsibility for designing a more practical service system, and for organizing and controlling its operation.

The purpose of this communication is (1) to suggest inauguration of a long-range planning program for the formation and eventual activation of a comprehensive system of services to provide permanently for adequate publication, distribution, and utilization of the scientific literature; and (2) to outline a specific plan that could serve as a basis for immediate consideration in such a program. Discussion will be restricted to comprehensive planning, on the premise that a single universal system functioning within a world association of scientists should, and eventually will, replace the many thousands of diverse and uncoordinated efforts now functioning as independent units.

Plans for reformation through comprehensive approaches have been advanced by Pownall (1) in 1926, Davis (2) in 1933, Bernal (3-5) in 1939, 1945, and 1948, Troy (6) in 1943, and Reid (7) in 1945. Bernal (3) mentioned that Federovsky in Russia and van Iterson in Holland had interested themselves in this problem, and that (4, 7) a group composed of members of the Association of Scientific Workers had put forward a fairly detailed scheme. Helpful discussions

bearing on the general problem and some bearing more specifically on comprehensive plans have been carried on by Pirie (8) in 1945, an editorial (9) in 1947, Davis (10, 11) in 1945 and 1948, Jurgens (12) in 1949, Taube (13) in 1949, and Merrill (14) in 1950. The Royal Society Scientific Information Conference held in London, June 21-July 2, 1948 (15), considered the many varied aspects of the whole scientific information problem. Although the seriousness of the deficiencies was recognized, solutions were sought more in improvements within the existing services than in basic changes. I am of the opinion that questions that have come to my attention (15, 16) with regard to the practicability and effectiveness of these comprehensive plans can be satisfactorily resolved. My own conclusions as to what seemingly should constitute effective means, although arrived at independently, are basically similar to some of those already proposed.

The timely emergence of a satisfactory system through normal evolutionary processes is unlikely, but the purposive construction and eventual activation of a plan providing a practicable system appear feasible. As a matter of judicious foresight, therefore, an active, long-range planning program for the organization and institution, on a scientific basis, of a permanent comprehensive service system should be inaugurated by scientists within the near future.

The program should involve, first of all, the formulation of a general plan for an ideal service system to serve as an ultimate goal and as a guide for current planning, practice, and research. It should then take up the selection, standardization, and integration into the plan of all essential components, and the setting of practical limits of necessary deviations from the plan in interim and ultimate practice. Analyses of service needs, of deficiencies in the present arrangement, and of available instrumentalities, the determination on the basis of these analyses of desirable characteristics in such a program and of suitable attributes in an ideal system, and the accomplishment of the necessary steps toward fulfillment are subjects which must receive careful attention, although they need not be developed here.

A PROPOSED BASIC PLAN

The plan herein presented is designed to serve as a basis for the organization and elaboration of services functioning in the publication, distribution, and utilization of scientific literature. Essentially it embodies a basic rearrangement and adaptation of selected

means in current use, which have been proved satisfactory and are appropriate, and it extends the application of these means to provide a comprehensive, scientist-directed system suitable for universal application. My confidence in the suitability and necessity of such an approach as this has been strengthened by reflection on accumulating and varied experiences during the years since the plan's conception in 1931. Originating out of personal experience with problems of utilization, the attempt has been made to form an ideal yet ultimately realizable system.

Essentials. The plan is based on the following points:

- a) Its objective is to bring about through a unified system of services a high degree of improvement in the availability of scientific information as an aid to the fullest possible realization of its value.
- b) The system envisaged is simple, flexible, universally applicable, and comprehensive of all services and all instrumentalities; it employs standardized and unified instruments and methods and is coordinated and integrated within itself and with scientific research institutions and scientific associations; and it performs all possible universally required services in a single processing at the time of original publication.
- c) Unit contributions are to be published separately.
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- e) The subject matter of all fields of science and of all the world's scientific literature is to be included.
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Publication media. The journal system lacks the flexibility essential for adequate distribution, manipulation, and utilization. Since contributions of related subject matter are scattered throughout and bound in a large number of diverse organs of distribution, accessibility is greatly restricted, and the contributions cannot be satisfactorily handled. Many papers are virtually inaccessible when they appear in obscure journals. The worker is delayed in receiving such items, and may forego their use altogether. Usually neither the worker nor his library can afford subscriptions to all the journals that may publish articles in the field. Much material distributed in journals is not related to the specialist's field of immediate interest, and much that is related might best be reviewed in summary form. Handling and storage of this unneeded material are also serious problems.

A basic change in the method of publication to provide for separate and independent treatment of each

unit contribution would give the requisite flexibility for meeting the demands of an efficient service. Forms of media appropriate to the requirements could be derived from forms in current use, such as the brochure employed by the Biological Society of Washington, and the permanent library reference and abstract card used by the Wistar Institute of Anatomy and Biology; or there could be more suitable new developments.

The form or brochure that is to be used primarily for full articles reporting research would serve also for translations, summaries and reviews, discussions and collections of scientific notes of permanent value, cumulative indices, classified abstracts, and advertisements. Local society news, announcements, accounts of proceedings, and remarks of temporary interest could be included, but might more appropriately be distributed independently.

The form, such as the library card, that is to be used primarily for combined reference and abstract information pertaining to the unit scientific contribution could serve also for publication of very short articles (notes) in their entirety in place of the abstract, and for brief announcement of work in progress as an aid to general organization of current research. The separate card system would serve the purposes of the central agency and of the scientific libraries, and would probably be the preference of many researchers. Cheap and rapid processes, such as microfilm and photoduplication, would be used for reproduction, according to requirements, of any information whether in manuscript or in one of the published forms. These would serve as the only method of publication in some cases, as well as for reproduction of information from reference cards assembled in subject-matter blocks, for preliminary announcements of forthcoming contributions, for detailed and "raw" data supplementing the published paper, for temporary working copies, and for distribution after the original supply of the regular issue is exhausted.

All media would be in standardized formats and would carry as a standard layout a complete orderly arrangement of reference, classifying, and indexing information, the acceptance date, and the name of the sponsoring organization.

The advantages to research scientists of having separates, references, and abstracts readily accessible in a working file are universally recognized. In the proposed system workers could have practically all desired current literature in specified subject-matter categories immediately available in forms that could be assembled, classified, cited, reviewed, filed, bound, and used in whatever ways seem best suited to their diverse needs and preferences.

Editorial. The editorial functions of the central agency would relate exclusively to routine processing. Content review and other strictly editorial functions for all articles and accompanying abstracts would be completely discharged, with full responsibility assumed, by originating agencies, as at present. Final approval of manuscripts would remain within the jurisdiction of the scientific societies.

In the same manner, a board of the world association would discharge editorial functions for all articles submitted directly to, or originated by, the association. The preparation of scientific and public information summaries could be sponsored by the association through the societies.

Subject matter classification and indexing. The range of subject matter would include all fields of science and all types of scientific literature: original articles, abstracts, lists of forthcoming and current articles, indices, reviews, and periodical summaries and interpretations. As part of the routine processing for issue, the subject matter of each contribution would be classified as to major categories, preferably with the collaboration of the author. The article would be indexed and coded and would be provided with classificatory symbols, an identifying serial number, and the acceptance date.

The scheme of classification would be basically stable, but modifiable on its periphery as required by changing emphasis and extensions of research fronts. The scheme would form a broad basis for further breakdown into specialized categories, for library use, for reviews, for use of mechanical and electronic devices such as a rapid-selector machine for sorting, for distribution by subject-matter blocks, and for citation purposes.

Languages and translations. The time and expense involved in translating articles from many different languages to the reviewer's own are very serious factors retarding research progress. Duplication of effort in this field is common and particularly wasteful. Far too often translations are inadequate, because sufficient preparation in several languages is impossible for most scientists. Distribution of prepared translations is almost nonexistent. Effective review demands that the literature be available in a language most easily and most quickly read; hence the use of a common language is the only practical solution.

I propose that each article with its abstracts, upon acceptance, be considered for distribution in the language in which it was originally submitted, in a common language, and in other accepted languages. Most articles with their abstracts would be published in the original language, although some of them, instead, could be distributed in the common language only. Requests for the article in the original language could be filled by reproductions from the manuscript. Some articles and many abstracts might be translated into various other languages, depending on the circumstances.

All abstracts and practically all articles would be translated into one accepted common language. The language chosen need not necessarily be accepted as a universal language. Publication could be, as needs dictate, in printed form, or as reproduction by cheaper processes.

Advantages are obvious. The subscriber would receive all literature in a familiar language. Translations would be superior, as they would have been done by professional language specialists (with ap-

propriate scientific backgrounds) in the country of origin and, whenever possible, would have been made with the active collaboration of the author. The language problem of individual investigators would be greatly reduced, since proficiency in only one language other than their own would ever be necessary. The intent is not to underrate language study for its practical and cultural value, nor for its value in interpretation of translated articles, but simply to recognize that accurate translation is a field for the professional.

Over-all costs would be greatly reduced. The translation, once published, would serve all researchers, everywhere, for all time. Once the plan is established, very likely an increasing number of articles would be originally submitted and published in the common language. Users, knowing that the author and central agency will be familiar with the single official translation, will be in a better position to obtain aid in its interpretation when needed.

Printing, reproduction, and binding. Printing and reproduction would be a responsibility of regional associations and of the world association, as appropriate. Suitable means would be provided for collecting and binding published articles. Both permanent- and temporary-type binders would be used. Binding would be in subject-matter or serial groupings, and would be done by the distributing agency or by the recipient, according to choice.

Distribution. Distribution would be by subscription and by special request. Subscriptions would be entered independently for each of the different services, such as for original articles in designated categories of subject matter and in specified available languages. Distribution would be a responsibility of regional associations and of the world association, as appropriate. Advertisements would be distributed as elected, which in most cases probably would be with the articles of appropriate subject-matter categories.

The system would assure all participants throughout the world of the equal opportunity for receiving any requested current literature as issued, as well as reproductions of any previously issued articles at any time on special request. The service would provide special bibliographies. Abstracts, references, and title announcements would be released and distributed immediately upon acceptance of articles for publication, serving to announce the articles and to invite special requests for specific publications.

Administration. Responsibility for administration would rest with an established world association of scientists. This might be accomplished through an expansion of the activities of the International Council of Scientific Unions. Actual direction would rest with a central directing agency created by, representing, and responsible to, the association. This agency would function according to standards and policies established by general agreement.

Service functions would be performed by a central action agency responsible to the central directing agency. All functions would be reduced so far as

practicable to routine processing, and full advantage would be taken of the high degree of mechanization to which the system would easily lend itself. The application and extension of currently available aids and the development of wholly new aids would be encouraged. The central agencies would work through local administrative branch units in the various societies.

Successful operation must derive entirely from basic soundness and satisfactory performance, not from governmental subsidy or from any form of coercion. The administration of the system must be free from entangling affiliations or commitments. The "monopoly" the world association might seem to possess would be balanced by the freedom of participants to dissociate and, if they so wish, set up independent services. This arrangement constitutes sufficient safeguard to insure that the system would be provided and maintained in a manner satisfactory to the users.

Originating agencies—authors, scientific associations, and research institutions—would, of course, be under obligation to comply with the general requirements of the system, but other than this, they would experience little change as regards administration. Their rights, freedom, and responsibilities should be no less than now.

Costs and financing. Over-all lowered costs and increased revenue may be expected to offset additional costs of new and extended services. Lowered costs should be realized from savings inherent in standardization, in elimination of duplication, in distribution according to need, in large-scale operation, and in mechanization. Costs of many times repeated services, particularly translations; of transportation, handling, and storage of much excess literature; of purchasing, mailing, and requesting reprints; and of library operation, would be greatly reduced. Much valuable time of investigators would be saved in all the manifold activities involved in using the literature.

Increased revenue should come from some of the same sources that now support publication. Complete service should stimulate an increase from subscriptions. Wider and more efficient distribution should enhance the attractiveness of the service for advertisers. Contributions should be increased from originating agencies in proportion to use, and from commercial and nonprofit institutions in recognition of the value of the service in time saved and in lowered costs.

Utilization. I believe that users and authors of scientific literature would find a comprehensive system best suited to their needs and to the advancement of scientific and public interest. A subscriber would be enabled to build up his reference file according to the special requirements of his fields of activity; his selections could follow his own developing specializations. A usual procedure at any point in his career would be selection of categories providing original articles in the immediate field of interest and such portions of related fields as appear appropriate, abstract reference information covering broader areas, and professional summaries and reviews covering as

wide a scope as he wishes. The opportunity to select the material to be received would obviate coercive purchase of unneeded literature, and permit his acquisition of a useful selection in its place. Needed references beyond, and to fill gaps within, the subscriber's selection, and literature for broader general reading should, as now, be obtainable from scientific libraries.

The scientific information would be more truly available for use, being classified and indexed for rapid and certain selection, in a familiar language, more suitably distributed, and in convenient form for handling, filing, and transporting. The greater ease in use made possible by this arrangement would greatly reduce time and effort, permit the user to direct his energy to higher levels of activity, aid him to perform much more purposive reading more easily, and enable him to increase his breadth of general reading. The system should prove particularly helpful to those whose fields of interest are widest and whose literature is now most widely scattered.

Advertisements could be classified and filed permanently, with advantages to both subscribers and advertisers.

Authors of scientific articles would be aided by facilitated reviews and by knowledge of articles soon to appear. Citation would be greatly simplified, because the serial number identifying each article would serve as a brief form of reference. For example, it alone could be used in the text, or in a subject file. Followed by classificatory symbols, article title, and author, a complete bibliographical citation would be formed. The finding of an article in a list or file would be easy, since its location would be fixed by the serial number in a strictly numerical filing system, and by the classificatory symbols plus serial numbers in a subject-matter filing system.

Priority would be determined by the acceptance date, which would be included with the indexing information. Authors would be assured that their contributions would become known immediately to those most concerned, through advance abstracts and title announcements.

The agency might well serve as a central depository of unpublished, as well as published, scientific information. Authors might deposit their raw experimental data and supplementary material with the central agency, thereby making it a matter of permanent record, available for duplication by any suitable process and for distribution at any time on special request.

Anticipated advantages to science and public interests follow from the advantages extended to individual users. The provision of a complete service under the guidance of a world association of scientists would resolve most known and anticipated problems, and bring within the realm of realization many needed functions and services now impossible. Expansion of established activities would automatically follow increasing numbers of scientific contributions and increasing service demands.

Scientific libraries would be relieved of much unnecessary routine work to undertake higher types of

activity, such as extended informational bibliographical summarizing, procurement, preparatory, and interpretation services. Literature would be more systematically filed in the library and would be better distributed among the units using the library. Elimination of thousands of journal titles and complicated reference procedures and the provision of prepared references and simplified citation would greatly reduce effort.

Research progress would be accelerated, because universal availability, greater facility in documentation, and improved correlation of information from individual contributions would give new value to the scientific literature. Duplication of research efforts and of the functions of the information services would be reduced, and over-all research planning would be greatly facilitated. Research activities could be extended and improved at greater distances from the great centers, and the problem of international exchange and dissemination of scientific literature would be resolved.

A challenging functional objective for an expanded world association of scientists would be provided, con-

tributing toward a further unification of the activities of scientists, raising the prestige of science and the scientific method, and, incidentally, engendering closer social and political unity throughout the world.

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Technical Papers

The Resistance of DDT-resistant *Drosophila* to Other Insecticides¹

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The literature of the past few years contains many examples of the development of strains of insects resistant to various insecticides. This resistance has been explained on the basis of the intense selection that occurs in treated areas. There is some variation in the results reported on the specificity of the resistance. Whereas early reports refer to a general hardiness with resistance extended from DDT to other insecticides (1), or to a specific resistance to DDT and very closely related compounds (2), the more recent investigations indicate that cross-resistance in DDT-resistant houseflies is neither highly specific nor broadly general, but of an intermediate nature (3, 4).

The purpose of this investigation was to determine the extent of the resistance of DDT-resistant *Drosophila melanogaster* to other contact poisons. *Drosophila* were used as test insects because of the ease with which they can be reared in large numbers in the laboratory and because of the possibility of much

more precise genetic analysis than would be possible with any other species. The resistant strain was obtained by growing the flies in a Teissier-type population cage (5). This enables the growing of a virtually undisturbed population of a few thousand flies with a continuously changing food supply.

Fine crystals of DDT were scattered in the cage in gradually increasing amounts as the flies became more resistant. At the end of a year, only about 5% were killed by a concentration of DDT that killed about 95% of the control flies. This selection procedure is not as efficient as could be used, particularly because of the uniformly greater susceptibility of males, and a more rapid increase in resistance undoubtedly could have been obtained by better selection methods. But it appeared to be the most nearly comparable to the situation as it occurs in nature and was adopted for that reason.

The flies to be tested were the descendants of flies taken from the selection cages and from a control population. They were tested at an age of 4 days with 5 doses of the insecticide to be tested. The dosage levels were equally spaced logarithmically, 150 flies of each sex and strain being tested at each dosage level. The insecticides were prepared as acetone solutions, and 0.5 ml of the solution was pipetted onto a rectangular filter paper 6 x 7 cm which was fitted into a glass vial. After the solution had dried, 20 flies of the same sex were placed in the vial at 26° C. Studies in this laboratory have shown that differences in hu-

¹ Paper No. 437 from the Department of Genetics, University of Wisconsin. This work was supported in part by the Research Committee of the Graduate School from funds supplied by the Wisconsin Alumni Research Foundation.

TABLE 1
MEDIAN LETHAL CONCENTRATIONS ($\mu\text{g}/\text{cm}^2$) FOR DDT-RESISTANT AND SUSCEPTIBLE *DROSOPHILA*

	Females			Males		
	Resistant (R)	Control (C)	Ratio (R/C)	Resistant (R)	Control (C)	Ratio (R/C)
DDT	2670	830	3.22	2460	550	4.47
Other chlorinated insecticides						
DDD	48.1	28.1	1.71	43.0	27.0	1.63
Lindane	0.141	0.0611	2.30	0.105	0.0447	2.34
118	0.0237	0.0199	1.19	0.0207	0.0148	1.40
Toxophene	2.98	1.85	1.61	1.66	1.09	1.53
Methoxychlor	23.9	15.9	1.50	21.7	14.2	1.52
Nonchlorinated insecticides						
Parathion	0.251	0.206	1.16	0.217	0.212	1.02
Sabadilla	1.11	1.18	0.94	1.12	1.10	1.02
Pyrethrum	122	127	.97	118	112	1.06
Nicotine	18.5	20.1	.92	18.6	17.1	1.09
TEPP	10.0	10.1	0.99	9.74	9.70	0.99

midity are responsible for great fluctuations in mortality; humidity was therefore kept constant at about 56%. At the end of 6 hr, the flies were removed and placed in food vials, and mortality counts were recorded 24 hr later. The reason for selecting 6 hr as the time of treatment is the peculiar shape of the dosage-response curves with DDT at longer periods of exposure, a relation which makes quantitative interpretation difficult.

Tests were made with 10 insecticides other than DDT. These were DDD, Lindane (benzene hexachloride), 118 ("Aldrin"), toxophene, methoxychlor, parathion, sabadilla, pyrethrum, nicotine, and TEPP (tetraethylpyrophosphate). Commercial grades were used. The DDT was a highly purified product furnished by E. I. du Pont de Nemours & Co.

The results of these tests are shown in Table 1 and Fig. 1. The median lethal dose was determined for most insecticides by Karber's method, which under certain assumptions provides a maximum likelihood solution (6). When this method was not applicable, the Fisher-Bliss maximum likelihood method was used (7). The LD_{50} is given in μg of insecticide/ cm^2 of filter paper area.

About 4 times the DDT concentration was required for the resistant strain as for the susceptible strain

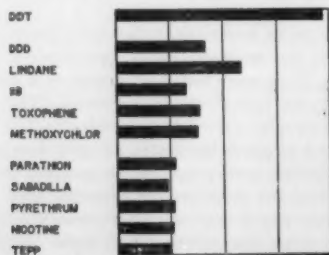


FIG. 1. Ratio of median lethal concentrations for resistant and control strains of *Drosophila* (av of both sexes).

from which it was derived. As can be seen from the table, the first 5 of the other insecticides tested showed a similar, but lesser, differential mortality between the 2 strains. All these are chlorinated compounds. On the other hand, there was no significant difference in the response of the 2 strains to the 5 nonchlorinated compounds. Thus it appears that when flies are selected for resistance to DDT there is some carry-over of resistance to other chlorinated compounds, but very little, if any, to other contact insecticides.

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The Relation of Oxygen Uptake to Hemoglobin Synthesis¹

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During an as yet unpublished investigation of the capacity of bone marrow of normal and x-irradiated rabbits to form hemoglobin, measurements of oxygen consumption during the first 3 hr of a 24-hr incubation period were carried out. Bone marrows of normal rabbits and of rabbits exposed to 800 r of x-rays were

¹ This paper is based on work performed under contract with the U. S. Atomic Energy Commission at the University of Rochester Atomic Energy Project, Rochester, N. Y.

removed at varying time periods after exposure to radiation. Homogenates were prepared from these marrows and incubated at 38° C in the presence of α -C¹⁴-glycine² as a hemoglobin precursor, as previously described (1, 2). Oxygen consumption of these homogenates was determined by means of the usual Warburg-Barcroft technique using modified 300-ml Warburg vessels. After incubation, hemoglobin was isolated by precipitation with 2.8 M phosphate buffer according to Green (3); from this preparation protoporphyrin dimethyl ester was isolated according to Grinstein (4) and globin according to Anson and Mirsky (5). The C¹⁴-activity of the products isolated was determined as described briefly in a previous publication (6). The relationship between oxygen consumption and hemin and globin synthesis under conditions which result in changes in the ability of the marrow to synthesize hemin and globin is apparent from the data presented in Table 1.

TABLE 1

Time after exposure to 800 r of x-radiation*	O ₂ -uptake μ l/g wet wt of marrow/3 hr	mM of hemin synthesized $\times 10^{-4}$ /mM of hemin isolated	mM of globin synthesized $\times 10^{-3}$ /mM of globin isolated
No radiation	218	6.2	3.3
0 hr	640	31.2	6.7
48 "	120	2.1	9.7
72 "	82	1.4	3.6
1 week	—	0.7	2.1
2 weeks	71	1.6	1.3
3 "	151	4.0	0.5
4 "	261	8.6	3.0

* The animals were sacrificed and bone marrows removed at the time indicated.

The number of millimoles of hemin and globin synthesized was calculated on the basis of the following considerations. The capacitance of the ionization chamber used for C¹⁴-analysis was determined. The change in voltage per minute permitted calculation of the number of radioactive atoms decaying per minute by use of the number of ion pairs produced by each particle. The number of atoms decaying per minute was related to the number of radioactive atoms present in accordance with the decay function. By correcting this number by a dilution factor, the number of atoms synthesized was obtained.

The results indicate a difference in the time relation between oxygen consumption and the synthesis of hemin and globin, respectively. It can be seen from Table 1 that hemin synthesis as well as oxygen consumption increases considerably in a parallel manner in homogenates from bone marrows removed immediately after radiation. Furthermore, oxygen consumption and hemin synthesis appear to reach a minimum about 1 week after exposure to radiation at a time

² We are indebted to the Isotopes Branch, Oak Ridge National Laboratory, for supplying the α -C¹⁴-glycine (C¹⁴-activity: 11.36 μ Ci/mg glycine) used in these experiments.

when marked degenerative changes prevail in the marrow. Globin synthesis also increases after radiation, but, in contrast to hemin synthesis, it reaches a maximum 48 hr after radiation at a time when oxygen consumption already approaches a minimum value. However, the decay curve of globin resembles in its shape that of oxygen consumption and hemin synthesis. Recovery of all three functions begins 2-3 weeks after radiation, which agrees well with histological findings.

A detailed investigation of the unexpected finding of increased oxygen consumption and hemin and globin synthesis in the early period following radiation is now in progress.

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Extensibility and Minimum Number of Polypeptide Chains in the Collagen Micelle¹

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The orderly pattern in which collagen diffracts x-rays is believed to depend on the presence of constituent ribbonlike units, or "micelles" (1, 2). Their accepted thickness is estimated to consist of about 4-6 parallel polypeptide chains (3), but neither the minimum total number of polypeptide chains forming each collagen micelle nor the number of chains lying in continuity within the micellar length is, to my knowledge, mentioned in the literature. Hence, in an attempt to estimate these figures, data on the physicochemical structure of collagen will be correlated.

From the study of the x-ray diffraction pattern of silk fibroin (4, 5) it is possible to infer that the polypeptide chain is probably the structural backbone in the molecule of the proteins of the fibrous class, to which both silk and collagen belong. In silk, where this chain is practically fully stretched and where the angles between bonds are almost planar, the individual amino acid residues take origin at a distance of 3.5 Å from each other (5). The length of an amino acid residue in collagen is about 2.85 Å (6), and this indicates that in this polypeptide chain the angles between bonds are smaller than the corresponding ones in

¹ This investigation was supported by the Institutional Grant of the American Cancer Society to the University of California School of Medicine.

² Damon Runyon clinical research fellow of the American Cancer Society, as recommended by the Committee on Growth, National Research Council.

³ I am indebted to H. F. Lundgren, Western Regional Research Laboratory, Albany, Cal., for his criticism.

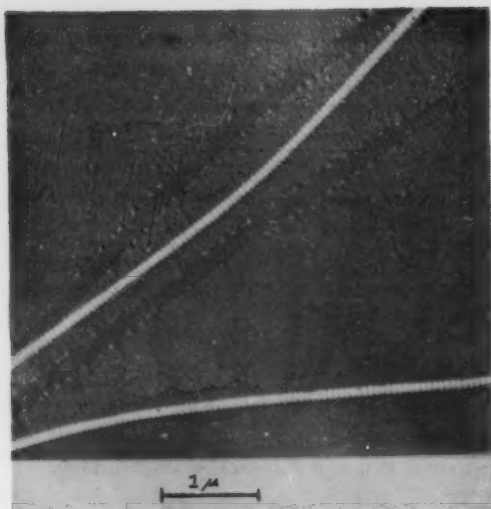


FIG. 1. Electron micrograph of individual collagen fibrils. Palladium shadowing ($\times 14,600$).

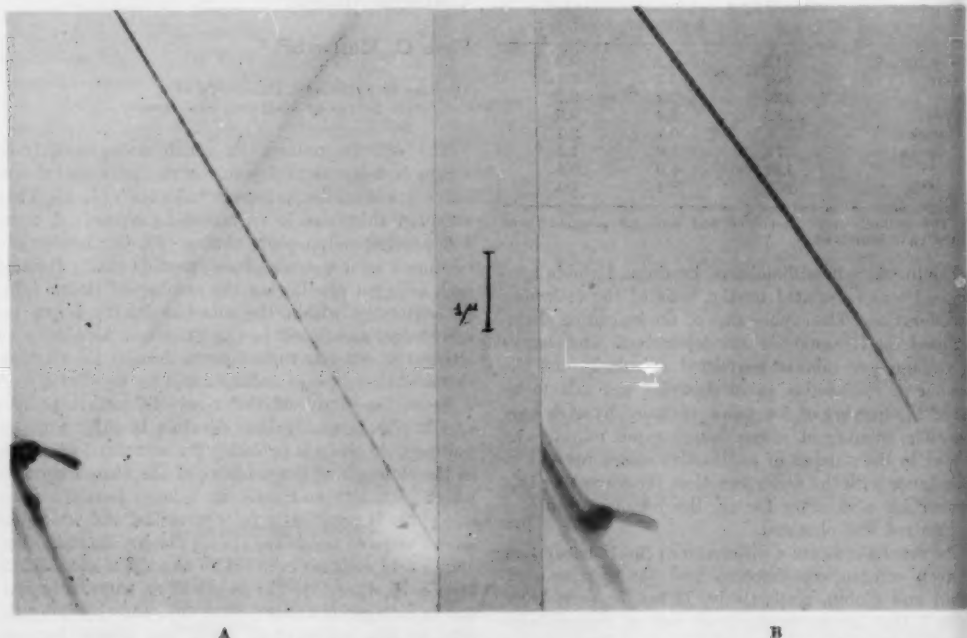


FIG. 2. Electron micrographs of single collagen fibril: A, the elongated axial periods of a stretched fibril, and B, the same fibril after rupture ($\times 12,700$).

fibroin and that, therefore, the polypeptide chain in collagen is, as a whole, slightly contracted.

The presence of fundamental periods averaging 640 Å along the collagen fibril, first deduced from x-ray diffraction studies (4, 5), is clearly demonstrable with

the electron microscope (Fig. 1) and was taken as a measure of the over-all length of the "molecule" (7, 8). A simple calculation indicates that a certain degree of curling takes place in the collagen "molecule" if the chemically individuated 421 amino acid residues (10) placed at intervals of 2.85 Å occupy a total length of only 640 Å and not of 1,200 Å as anticipated. On the other hand, it will be realized that the deformational properties of individual fibrils allow a considerable stretching of the axial periods before rupture occurs (Fig. 2).

Periods elongated up to 5,800 Å have been reported (7). However, the total obtainable increment compatible with the integrity of a fibril being stretched as a result of the physical changes occurring in the supporting metallic grid cannot be measured directly on electron micrographs. In fact, the maximally stretched period remains at its newly acquired length only for a fraction of the time needed for a photographic exposure. Nevertheless, this maximal elongation may be estimated fairly accurately by photographing a stretched axial period, by then evaluating the extent of the residual elongation that will culminate in its rupture, and finally by correcting accord-

ingly the measurements taken on the picture. Estimates obtained with this method indicate that an axial period may elongate up to 6,700 Å–6,900 Å before breaking. In another set of experiments, collagen fibers were forcibly stretched in water, quick frozen and

lyophilized.³ The procedure resulted in various degrees of elongation of the axial periods. In a series of 75 individual fibrils so treated, the greatest elongation found in an axial period was of about 7,000 Å, as close as could be measured (Fig. 3). This measured value seems to parallel the figures of the obtained estimates.

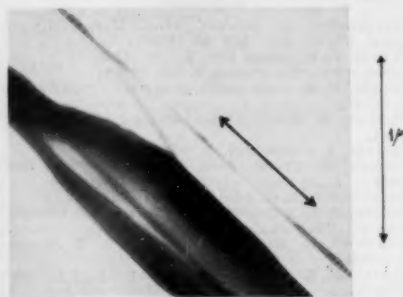
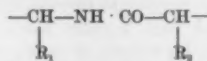


Fig. 3. Electron micrograph of a collagen fibril stretched and lyophilized. The period parallel to the arrow measures approximately 7,000 Å ($\times 35,000$).

The stretching undergone by the fibrils may be thought of as the summational effect of the uncoiling of the constituent molecules. This uncoiling is believed to be conditioned and limited by the rotational possibilities about the involved bond. In the established concept (9) that the collagen micelle contains parallel chains of the general form



proline and hydroxyproline are built into chains forming imino links



believed to restrict rotation about these atoms. Because of the large proportion of such radicals, approximately 1 in 4 (10), full extension of the polypeptide chain in collagen cannot be achieved and complete flattening of the bond angles cannot be obtained.

If 7,000 Å is accepted as the correct value, it then seems logical to infer that no less than 6 such chains are linked in series within one axial period of 640 Å in order to account for the observed magnitude of extensibility in the fibril. It is interesting to compare this figure with the number of intraperiodic bands or elevations demonstrable with special techniques in collagen fibrils.

The six intraperiodic bands that can be resolved in fibrils "stained" with phosphotungstic acid (7) indicate a preferential affinity for the acid at six distinct levels of the axial period and suggest the presence of six repeating elements within its over-all length. The six intraperiodic elevations visible in electron micrographs of unstained but shadowed collagen concur with this suggestion.

From the considerations made above, the minimum

total number of polypeptide chains in the collagen micelle will be:

$$n = 6 \text{ (polypeptide chains linked in series)} \times 4-6 \text{ (polypeptide chains linked in parallel)} = 24-36.$$

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The Use of Oxalate to Produce Free-living Cells from Carrot Tissue Cultures

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At the turn of the century Haberlandt (1) formulated the concept of plant tissue culture but was unsuccessful in obtaining proliferating cultures from single isolated cells. Various workers (2) since that time have tried in vain to obtain tissue cultures derived from different kinds of single isolated plant cells. The sole exception to these negative results is an unconfirmed report by Schmucker (3), who obtained division of the spongy mesophyll cells of *Bocconia*. White (4) has suggested that the cause of failure is the use of mature, and hence unsuitable, cells. The purpose of the present report is to describe a chemical method whereby single viable bacteria-free cells of varying age and size may readily be obtained from plant tissue cultures.

The method was suggested by the researches of Herbst (5), who demonstrated that fertilized eggs of *Echinus*, when grown in artificial sea water deficient in calcium, divide to form cells that soon separate. Since the cementing material of plant cells is commonly calcium pectate (6), it was assumed that the omission of calcium might cause separation of the cells. Heller (7) recently grew carrot tissue on filter paper in the absence of calcium and noted a decreased growth rate, but made no mention of the friability of the tissues. In the present experiments the oxalate method of Pringsheim (8) was used to bind free calcium. The basal growth medium was that of White (9), with sodium nitrate substituted for calcium nitrate. The medium contained 10-7 M naphthalene acetic acid, 10-5 M cysteine hydrochloride, 10-6 M thiamine hydrochloride, and 10% coconut juice. The pH was adjusted to 5.7. To this medium increments of ammonium oxalate were added in the amounts of 0,

*Details will be published elsewhere.

100, 200, 300, 400, 500, 600, 700, 800, 900, and 1,000 $\mu\text{g/ml}$ (ppm), respectively.

One set of experiments was executed in 50-ml Erlenmeyer flasks containing 4 ml of carrot medium solidified with 0.8% agar. A second set of experiments was conducted in pyrex side-arm test tubes containing 4 ml of liquid medium. Cultures in test tubes were aerated with air forced through a solution of 10% potassium dichromate in sulfuric acid, sterile water, and numerous sterile cotton plugs placed at intervals in the rubber tubing connecting the test tubes. The cultures did not become contaminated. Each concentration of oxalate, solid and liquid medium, was run in duplicate. Inoculation was made with sterile 5-mg pieces of carrot removed by a cannula from the cambial region of a carrot root. After inoculation the cultures were placed in the dark at room temperature.

At the end of 10 days the cultures were examined. Aerated cultures were especially friable and crumbled readily. Indeed, some cultures had spontaneously broken into large or small pieces while growing. Certain tubes and flasks contained cultures with free single cells. In both tubes and flasks lower increments of oxalate (100 $\mu\text{g/ml}$) allowed both proliferation and production of loose cells. These were easily dislodged from the flask cultures by a glass needle or could be readily sucked into capillary pipettes when the tissue mass was placed in aqueous medium. Higher oxalate increments retarded the growth of the cultures. Aerated cultures had shed many cells into the surrounding medium. The cells were of many shapes and sizes, some ranging up to several hundred μg in length. Most cells were bean- or banana-shaped, but a few had single emergences resembling embryonic root hairs. Many cells were disorganized and obviously dead, but many other cells were visibly living, with nucleus, vacuole, plastids, granules, etc., plainly evident upon microscopic examination.

Viability of the cells was tested in two ways. One method was by direct microscopic observation of normal cells. This was done by sucking cells aseptically into sterile micropipettes, whose ends were then sealed with sterile paraffin. This permitted repeated observation of individual cells. Cytoplasmic streaming could be seen because of the orderly movement of material suspended in the cytoplasm, and was especially evident in the strands of cytoplasm traversing the vacuole. Some cells showed cyclosis at the end of 10 days even under these relatively anaerobic conditions. The other method of testing for viability was by means of the colorless dye 2,3,5-triphenyltetrazolium chloride. This dye turns pink or red when reduced, and has recently been widely used to distinguish living from dead cells (10). Cytoplasmic granules of many single carrot cells subjected to 500 $\mu\text{g/ml}$ of the dye for 12 hr were pink, thus demonstrating their reducing ability, a common property of healthy protoplasm. Dead cells did not change the color of the dye.

In a recent publication, White (11) has commented that not enough is known about plant hormones at the cell level. It is hoped that the facility of the method

here reported and the present widespread use of plant tissue culture techniques will stimulate the study of single cells and eventually lead to a better understanding of the interrelationships of plant cell and hormone. The effects of various chemicals on single carrot cells is being investigated.

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The Effect of Heated Linseed Oil on Reproduction and Lactation in the Rat^{1,2}

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A series of experiments carried out in this laboratory during the past 4 years has shown that diets containing 10% by weight, or more, of heated linseed oil are less nutritious than diets containing the same amounts of unheated linseed oil, the effects having been gauged by live-weight gains, efficiency of feed consumption, and time of survival (1, 2). In this connection "heated oil" signifies oil heated in the absence of oxygen at 275° C. Impairment of nutritive value has been observed with oils heated for as short a period as 4 hr. It has been shown in the test herein reported that reproduction and lactation are impaired in the female rat by diets containing 10% of the heated oil.

The experiment used 72 female albino rats distributed among 4 diet groups of 18 rats each. The rats received the experimental diets from the time of mating until the end of the subsequent lactation. Groups 1 and 3 received the heated oil diet, and Groups 2 and 4 the unheated oil diet. Rats of Groups 3 and 4 received in addition a supplement of 20 mg α -tocopherol per week.

Immediately before parturition, the females were put into individual wire-mesh cages. The cages were

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² This test is a part of a larger project undertaken for the Committee on Edible Fats and Oils of the National Research Council of Canada, whose financial assistance is acknowledged. Paper No. 259 of the Canadian Committee on Food Preservation.

TABLE 1

INGREDIENT	%
Ground wheat	28
Dehydrated cereal grass	7
Fishmeal	15
Ground oat groats	10
Wheat germ meal	10
Ground corn	9.5
Soybean oilmeal	5
Irradiated yeast	3
Bone meal	2
Iodized salt	0.5
Linseed oil*	10

* Heated at 275° C in a current of CO₂ for 12 hr in the case of Groups 1 and 3.

fitted with a nesting box having a solid floor, and shavings were supplied for the nest. Feed and water were offered *ad lib*. Neither live weights nor feed intakes were recorded for the mothers, but litter weights were recorded for the 7th, 14th, and 21st days. On the 7th day litters of 9 or more were reduced in size to 8 rats each.

All diets used in this experiment had the general formula given in Table 1.

Table 2 shows the effect of heated linseed oil on the survival of young rats.

TABLE 2

EFFECT OF HEATED LINSEED OIL IN THE DIET OF THE FEMALE RAT ON THE SURVIVAL OF HER YOUNG

Lot No.	Vitamin E supplement	Linseed oil treatment	No. litters born	Total born alive	Average litter size at birth	Average no. young alive per litter at ages noted (days)			
						7	7*	14	21
1	Nil	Heated	14	118	8.4	2.1	2.1	0.1†	0.1†
2	"	Unheated	14	161	11.5	5.5	4.6	4.0	3.9
3	Vitamin E	Heated	12	99	8.3	2.8	2.7	0.1†	0.0
4	"	Unheated	15	160	10.7	8.0	6.2	6.1	5.9

* After reduction of litters to 8 rats/litter where applicable.

† Represents 1 rat in 1 single litter only.

TABLE 3

ANALYSIS OF VARIANCE OF THE SURVIVAL OF YOUNG RATS

Source of variance	D/F	No. born alive per litter		Alive at 7 days		Alive at 21 days		Necessary F values	
		Variance	F ratio	Variance	F ratio	Variance	F ratio	5%	1%
All causes	54								
Treatments									
Heat	1	101.6	9.2	261.8	16.9	328.2	55.5	4.03	7.17
Vitamin E	1	1.9	—	46.8	3.0	24.4	4.1	4.03	7.17
Interaction	1	3.3	—	.9	—	6.9	1.2	4.03	7.17
Remainder (error)	51	11.1	—	15.5	—	5.9	—		

Differences in numbers of females that produced litters are probably entirely dependent on the numbers that conceived, since no evidence of abortion was found. Inasmuch as the rats were not placed on the test diets until they were mated, we do not believe the differences among the four groups in numbers of litters born are related to the experimental diets fed.

The first evidence of disturbed reproductive function was the smaller numbers of rats born to the females receiving the heated oil diets. In addition to this, the viability of the rats born to these groups was clearly inferior to that of the rats born to the groups receiving unheated oil diets.

Table 3 gives an analysis of variance for the number of young born alive, and of those still surviving on the 7th and on the 21st days.

It will be evident from Table 3 that the heated oil has had a highly significant adverse effect on the number of rats born alive and on their survival through the normal nursing period of 21 days.

Data for the changes in weight of individual rats are not available, since the litters were weighed as groups. The records for survival of individual young showed that they died over a period of about 2 weeks. Only 1 rat out of some 200 born to mothers on heated oil diets still survived on the 14th day. No valid comparison of weights can be made between groups because of the constantly diminishing numbers of survivors in many of the litters. Before the young on the heated oil diet died, they lingered for several days in a moribund condition. Another abnormal condition

was also noted. Whereas on normal diets individuals in small litters (5 or 6 rats per litter) tend to be heavier than those in litters of 10 or 12 young, the animals in the small litters on the heated oil diets contained the smaller individuals. It has not been determined to what extent the death of the young was a consequence of starvation.

The supplement of α -tocopherol under the circumstances of this experiment did not measurably counteract the damage from the heated oil diets. The just significantly greater number of survivors at 21 days in the vitamin E group as compared to the number receiving no vitamin E is possibly explained on the basis of variability between tests, since all the animals receiving vitamin E were fed at one time and those receiving no vitamin E at a different time.

The proportion of young surviving or retained at 7 days, which were eventually weaned, is rather poor in the case of the rats receiving the unheated oil diet. We are inclined not to attribute this to any nutritional defect of the oil, since linseed oil included in the diet at levels of up to 30% has been observed to give rates of gain and feed efficiency comparable with those given by other edible oils when included in the diet at the same levels (1).

It is, however, quite clearly evident that heating the oil damaged its nutritive value. The reproductive and lactation responses of the female rat and her litter may offer a more critical test of thermal damage to oils intended for dietary use than does the growth of the weaned rat.

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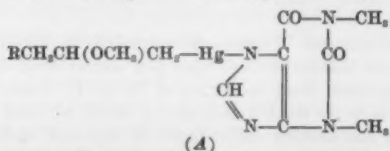
Reactions of Mercurial Diuretics with Mono- and Dithiols

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A recent review on renal transport mechanisms summarizes as follows: "There can be little doubt that the kidney is the principal site of the diuretic effect of the mercurial agents. . . . In general, mercurial agents combine with sulfhydryl groups, and this is responsible for their inhibitory effect on a number of essential cellular dehydrogenases. That the diuretic effect of mercury is attributable to the inhibition of such enzymes seems likely . . ." (1). The purpose of this communication is to describe certain reactions that occur *in vitro* between mercurial diuretics and thiols and to discuss their physiologic significance.

Prior to 1949 the mercurial diuretics used in medicine could be grouped under the general structure

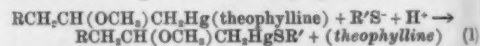


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TABLE 1
RECOVERY OF THEOPHYLLINE FROM THE REACTION
BETWEEN MERCURIZANTHIN AND VARIOUS
SULFHYDRYL COMPOUNDS

Monothiois	Mols theo- phylline recovered per mol mercury
Potassium ethyl xanthate	1.12
$\begin{array}{c} \text{S} \\ \parallel \\ \text{C}_2\text{H}_5\text{O}-\text{C}-\text{SK} \end{array}$	
Thiourea	1.06
$\begin{array}{c} \text{NH} \\ \parallel \\ \text{NH}_2-\text{C}-\text{SH} \end{array}$	
N-methyl thiourea	0.89
$\begin{array}{c} \text{NH} \\ \parallel \\ \text{CH}_3\text{NH}-\text{C}-\text{SH} \end{array}$	
Thiouracil	1.20
$\begin{array}{c} \text{CO}-\text{NH} \\ \parallel \quad \parallel \\ \text{CH} \quad \text{CSH} \\ \parallel \quad \parallel \\ \text{CH}-\text{N} \end{array}$	
Sodium thiosalicylate	1.17
$(\text{NaOCO})\text{C}_6\text{H}_4\text{SH}$	
Thioacetamide	1.23
$\begin{array}{c} \text{NH} \\ \parallel \\ \text{CH}_3-\text{C}-\text{SH} \end{array}$	
Sodium thioglycollate	1.06
$(\text{NaOCO})\text{CH}_2\text{SH}$	
Sodium salt of cysteine	1.08
$(\text{NaOCO})\text{CH}(\text{NH}_2)\text{CH}_2\text{SH}$	
Sodium thiosulfate	1.06
$\begin{array}{c} \text{O} \\ \parallel \\ \text{O}=\text{S}-\text{SNa} \\ \diagup \\ \text{NaO} \end{array}$	
Thio phenol	1.12
$\text{C}_6\text{H}_5\text{SH}$	

where R is usually the sodium salt of a carboxylic acid residue to which the three-carbon side chain is attached through the nitrogen atom of a carbamyl group. It has been found that these drugs, represented by Mercanzanthin (Mercurophylline, U.S.P.), Salyrgantheophylline (Mersalyl with theophylline, U.S.P.) and Merahydrin (Meralluride, N.N.R.), will react immediately at room temperature with a wide variety of monothiois according to the following equation:



where R'SH may be any simple sulphhydryl compound. If the reaction is carried out in concentrated solution and the rise in pH caused by removal of hydrogen ions is prevented by buffering with CO_2 , the theophylline precipitates quantitatively.

To 10 ml of 0.2 M Mercuexanthin solution was added a mol equivalent of the various sulfhydryl compounds listed in Table 1. The solution was then saturated with CO₂ and the precipitated theophylline monohydrate was filtered off on a sintered glass filter, washed with a small volume of ice water, dried in a desiccator, and weighed. From the

TABLE 2
ESTIMATION OF UNBOUND SULFHYDRYL GROUPS IN THE
REACTION OF MERCUZANTHIN WITH EXCESS
THIOGLYCOLLATE

mM of mercury taken as Mer- cuzanthin	mM of sodium thiogly- collate added	mM of -SH recovered	Mols of -SH bound per atom of mercury
0.193	0.214	0.025	0.98
.193	.214	.023	0.99
.193	.333	.138	1.01
.193	.416	.222	1.02
.193	.428	.230	1.03
.187	.669	.477	1.03
0.187	0.669	0.476	1.03

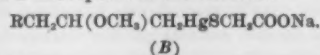
weight of theophylline found (corrected for the solubility of theophylline in the reaction mixture) it was possible to calculate the approximate mols of theophylline precipitated per mol of mercury which appear in the table.²

However, this reaction also goes to completion in dilute solution at physiologic pH without the separation of theophylline. This was shown as follows:

To one ml of a 0.2 M solution of Mercuzanthin in 10 ml of phosphate buffer, pH 7.4, were added varying amounts of an approximately 0.2 M solution of sodium thioglycollate, and the mixture was immediately titrated with 0.1 M potassium ferrieyanide until a pale-green color appeared which persisted for 10 sec. The thioglycollate solution was standardized iodimetrically; the results agreed with those obtained by ferrieyanide titration. Furthermore, the total -SH in the reaction mixture can be titrated iodimetrically in the presence of mercury. The difference between the mols of thioglycollate recovered and added is equivalent to the mols of mercury bound as mercaptide. The data in Table 2 are also in agreement with equation (1).

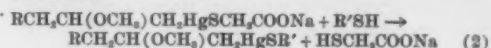
Most tissues and fluids in the body contain glutathione and cysteine as well as proteins bearing thiol groups which are readily accessible to mercury. In fact Milnor (2) has shown that Mercuhydrin, a mercurial of structure (A), is partially bound *in vitro* by plasma protein. Hence it may be considered almost inevitable that reaction (1) takes place *in vivo* and that the xanthine-bearing diuretics circulate in the blood as mercaptides formed from simple thiols or plasma albumin.

Recently the mercurial diuretic Thimerin (Mercaptomerin, N.N.R.) has been shown to be at least as potent a diuretic as the drugs of structure (A) (3, 4). It has also been shown that the time of onset and course of excretion of mercury, water, and chloride after administration of Thimerin and Mercuzanthin are virtually identical (5). It was anticipated that Thimerin might not have diuretic properties at all since it is a mercaptide of the structure



² Acetamide and urea do not precipitate theophylline under these conditions in contrast to their thio analogs, which behave like true sulfhydryl compounds.

That it is a diuretic can best be explained on the basis of an exchange reaction at the tubular cell at which site it may be expected to attain a relatively high concentration.



where R'SH may represent an enzyme bearing one or more sulfhydryl groups. Webb, Bhatia, Corwin, and Sharp (6) have shown that such reactions proceed at physiologic temperature and pH. Alternative mechanisms are, of course, possible.

TABLE 3
IMMEDIATE REACTION BETWEEN BAL
AND MERCUZANTHIN

mM of mercury taken as Mer- cuzanthin	mM of -SH added as BAL	mM of -SH recovered	Mols of -SH bound per atom of mercury
0.094	0.430	0.342	0.95
.094	.434	.347	1.04
.094	.434	.343	0.98
.097	.430	.333	1.00
.155	.430	.280	0.97
.187	.430	.265	.88
.187	.434	.260	.93
0.194	0.430	0.248	0.94

On the other hand, it has been demonstrated, both in animals and in man, that administration of British antilewisite during mercurial diuresis resulting from compounds of structure (A) (7-9) or from Thimerin (10) will rapidly but transiently suppress the diuresis. Although this phenomenon has been attributed to stimulation of production of the antidiuretic hormone by BAL (9), it nevertheless seemed desirable to determine the nature of any reactions which might occur between BAL and the mercurial diuretics.

Immediate reaction with BAL. One half to one ml of a 0.2 M solution of Mercuzanthin was mixed with 10 ml of phosphate buffer, pH 7.4, and a stream of nitrogen was run into the reaction flask and maintained throughout the experiment to prevent air-oxidation. One ml of an ethyl alcohol solution of BAL, approximately 0.43 N with respect to -SH, was then added, and the mixture immediately titrated with 0.1 M potassium ferrieyanide solution to the same end point as before. The reaction was carried out at room temperature.

The values for recovered -SH in Table 3 indicate the binding of one -SH group for each atom of mercury present. The titer of BAL determined by ferrieyanide titration agreed closely with that obtained iodimetrically.

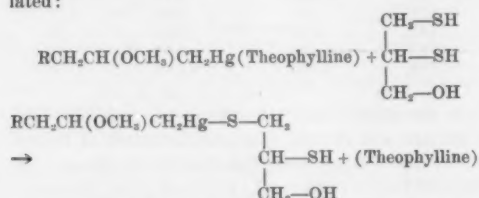
Progressive reactions with BAL. One hundred ml of phosphate buffer, pH 7.4, 9 ml of Mercuzanthin, and 11 ml of an alcoholic solution of BAL were mixed under nitrogen and maintained in a water bath at 37.5° C. The final solution was such that each 10-ml sample contained 0.143 mM of mercury and 0.687 milliequivalents of -SH. At timed intervals 10-ml aliquots were removed from the reaction mixture and titrated with 0.1 M potassium fer-

TABLE 4
PROGRESSIVE REACTIONS BETWEEN BAL
AND MERCUZANTHIN

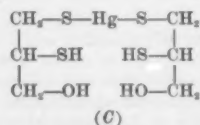
Time after mixing (min)	Mols of -SH bound per atom of mercury
5	1.17
15	1.31
30	1.73
45	2.01
60	2.27
75	2.55
90	2.67
120	2.67

ricyanide. One tenth ml of a 0.5% copper sulfate solution added to each titration flask was found to give a sharper end point. An aliquot removed after 85 min was titrated iodimetrically and showed no loss in total -SH. The drop in potassium ferricyanide titer is then assumed to be due to the formation of mercaptides. The results are given in Table 4.

The immediate reaction which occurs with the disappearance of 1 SH/atom of mercury may be formulated:



This reaction proceeds further with the disappearance of 2-3 mols of SH per atom of mercury. Presumably the C-Hg bond is ruptured with the formation of some such complex as that suggested by Gilman and co-workers (11).



It is also of interest that these reactions are progressively accelerated as the pH is reduced below 7.

In summary, it is felt that a mercurial diuretic, whether of the xanthine or mercaptide type, circulates in the blood as a mercaptide derived either from a simple monothiol or a protein. At the site of mercurial diuresis a reaction similar to (2) may occur between the mercurial and an enzyme bearing essential sulfhydryl groups. If there is more than one SH group present on the same molecule the mercury may be removed from the parent drug and temporarily bound. Rapid reactivation of the enzyme and excretion of the mercury undoubtedly occur, however, since no permanent damage is done to the kidney even on frequent administration over long periods. Removal of mercury from such an enzyme-mercury complex by BAL with

suppression of diuresis would be anticipated and resumption of diuresis could occur from fresh mercurial presented to the kidney.

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Sedimentation Cylinder for Particle Size Analysis

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Among the simplest of the techniques for separation of fine-grained sediments into fractions based on particle dimensions is gravity settling followed by decantation, involving the settling of sediments in liquids in accordance with Stokes' law. In a recent analysis of a suite of samples it became necessary for the writer to isolate the 1/32-1/16 mm grade size for further study, and for this purpose a settling cylinder was devised, incorporating the best features of the Kühn settling tube (1) and the Atterberg sedimentation cylinder (2). A side opening was drilled into an ungraduated liter cylinder, far enough above the base of the cylinder so that the streamlines created by flow through the opening would not affect the sediment that had come to rest on the bottom of the cylinder or on the surface of the base of the stirring rod (in this case a rubber stopper attached to a glass rod). Flow through the side opening of the cylinder was regulated by means of a stopcock in a length of glass tubing, held in the opening by insertion of the tube through a hole in a rubber stopper (Fig. 1). Water was allowed to drain through the side outlet, and when drainage ceased, heights of 5 cm, 10 cm, and 20 cm above the level of the water remaining in the cylinder were marked on the cylinder walls, and these levels were etched into the glass of the cylinder. In Fig. 1 the etched lines are marked with wax pencil, and the levels just described are represented by the upper line of each pair of black lines.

The procedure in the analysis for which the apparatus was devised consists of the introduction of a sediment suspension (from which oversized material has been removed by wet sieving through a U. S. Standard No. 230 sieve) into the cylinder and the



FIG. 1. Sedimentation cylinder with stopcock on side opening. Heights of 5 cm, 10 cm, and 20 cm above side opening are marked by upper lines of line pairs; distance between two lines of each pair represents 20-ml volume.

addition of water to bring the level of the suspension to the 10-cm line. The stirring rod remains in the cylinder throughout the process. After thorough mixing to obtain uniform distribution of particles, the sediment is allowed to stand for 1 min 56 sec, at which time the stopcock on the side outlet is opened and the supernatant liquid drained. The process is repeated until, at the end of the settling period, the liquid above the level of the side outlet is free of sediment, indicating that all particles finer than $1/32$ mm have been removed; material coarser than $1/32$ mm is recovered from the bottom of the cylinder by inverting the cylinder and flushing the sediment into an evaporating dish. The grain diameter at which the split is made depends on the settling time and the height of the liquid column above the outlet, and by proper choice of these factors, determined from Stokes' law, any diameter less than $1/16$ mm may be used as the critical size.

A variation of the procedure, which perhaps lessens the number of decantations required for a single sample, consists of restoring the suspension to the 20-cm line instead of the 10-cm line after each decantation, and doubling the settling time after agitation.

Because it was not required by the study for which the apparatus was constructed, the volume of the liquid within the cylinder was not calibrated, but if, in planning the position of the side outlet on the cylinder wall, the height within the cylinder of the column of a measured volume of water (e.g., 1 liter) is used to determine the position of the topmost marking, then an outlet similar to that shown in Fig. 1 can be inserted 5 cm, 10 cm, or 20 cm below this level, and a second marking can be etched in the cylinder to represent a volume 20 ml less than the starting volume, shown in Fig. 1 as the lower line of each pair of lines. Using the appropriate pair of lines, the appa-

ratus then may be used for size frequency analysis of fine-grained sediments according to the pipette method (3, 4), but without the use of a pipette. Careful manipulation of the stopcock on the side outlet will permit the withdrawal of exactly 20 ml of the suspension from a depth of 5 cm, 10 cm, or 20 cm below the surface of the suspension, in accordance with the times and heights of liquid column required by Stokes' law. After each withdrawal, the level of the suspension must be restored to the appropriate height above the side outlet, and, in addition, after the first withdrawal a correction for the decreased weight of dispersing agent in each succeeding aliquot must be made, as each withdrawal and restoration of liquid level will decrease the concentration of the dispersing agent remaining in the cylinder. The system must be reagitated thoroughly between sample withdrawals.

In the original apparatus the end of the stopcock tube and the rubber stopper through which it is inserted create a slight obstruction to the free fall of sediment particles along the cylinder wall in which the side outlet was made; as a result, some sediment is caught on this shoulder. A person experienced in the working of glass could fuse the tube to the cylinder with a smooth joint, and thereby overcome this difficulty.

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Hormonal Influence upon the *in Vitro* Synthesis of Radioactive Fatty Acids¹

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Within the past few years, substantial evidence has accumulated suggesting that experimental diabetes is associated with a major derangement of lipid metabolism. Stetten and Boxer (1) demonstrated that there is a marked impairment of fat synthesis in the diabetic animal when compared with the normal. Brady and Gurin (2-4) have shown that the conversion of radioactive acetate to long-chain fatty acids by rat liver slices is diminished in the case of alloxanized rats or depancreatized cats to less than 1/10 that of the normal. Attempts to reverse this failure of fatty acid synthesis by the addition of insulin, glucose, fructose-6-phosphate, oxalacetate, or α -keto glutarate to liver slices of diabetic animals have been unsuccessful (4). Although the addition of insulin to liver slices of normal rats stimulated, to a significant degree, the con-

¹ Aided by grants from the American Cancer Society administered by the Committee on Growth of the National Research Council, and from the National Institutes of Health, U. S. Public Health Service.

TABLE 1
CONVERSION OF RADIOACTIVE ACETATE TO LONG-CHAIN FATTY ACIDS BY LIVER SLICES

Exp. No.*	Condition of cat	Urinary glucose (g/kg/day)	Substrate		Insulin	Recovered long-chain fatty acids			
			Formula	Radioactivity administered (cpm)		Mg/2.5 g liver slices	Radioactivity (cpm)	Administered radioactivity (%)	Substrate incorporated† (μM)
1	Fed normal	—	C ¹⁴ H ₃ COONa	17,000	—	106	910	5.4	4.0
	" "	—	"	17,000	+	100	1,500	8.8	6.5
2	Fasted (48 hr) normal	—	"	17,000	—	200	910	5.4	4.0
	" " " "	—	"	17,000	+	203	1,400	8.2	6.1
3	Fasted (48 hr) pancreatectomized	3.3	"	17,000	—	57	87	0.5	0.4
	Fasted (48 hr) pancreatectomized	3.3	"	17,000	+	61	88	0.5	0.4
4	Fasted (48 hr) pancreatectomized	6.6	CH ₃ C ¹⁴ OONa	12,000	—	175	68	0.6	0.4
	Fasted (48 hr) pancreatectomized	6.6	"	12,000	+	180	68	0.6	0.4
5	Houssay	0.8	C ¹⁴ H ₃ C ¹⁴ OONa	14,000	—	60	1,360	9.7	7.5
	"	0.8	"	14,000	+	60	1,920	14.	10.6
6	Houssay	0.7	"	14,000	—	57	910	6.5	5.0
	"	0.7	"	14,000	+	59	1,480	10.6	8.2

* All experiments designated by the same number were performed on aliquots of pooled liver slices.

† Total recovered radioactivity (counts/min).

counts/min/micromole of substrate

version of labeled acetate to fatty acids and cholesterol, no such effect was obtained with liver slices of diabetic rats or cats. It appeared probable, from these experiments, that the *in vitro* action of insulin was an indirect, secondary effect; that it merely made available extra energy for the synthesis of fatty acids and cholesterol by liver slices of normal animals. In order to determine whether insulin is at all necessary for the *in vitro* synthesis of fatty acids by liver, similar experiments have been performed with surviving liver slices obtained from depancreatized, hypophysectomized (Houssay) cats.

The completeness of the surgical procedures employed was established by measuring the fasting excretion of glucose and nitrogen. Further confirmation that the pancreas and hypophysis had been completely removed was obtained by gross and histological observations at autopsy.

The cats were anesthetized by intraperitoneal injection of Nembutal, the livers removed, and slices prepared with a Stadie slicer. Two and one-half g of slices were placed in large Warburg vessels (250-ml capacity) containing 15 ml of Krebs-Ringer bicarbonate buffer solution at an initial pH of 7.4 and C¹⁴-labeled sodium acetate in a final concentration of 0.005 M. The gas phase was 95% O₂-5% CO₂. The slices were incubated for 3.5 hr at 38.4° C. In those experiments in which insulin was employed, 1 mg of electrophoretically homogeneous insulin² was dissolved in 1

ml H₂O, brought to pH 7.4 and added to the incubating medium.

Following incubation, the liver slices were saponified, and the long-chain fatty acids were recovered and purified as previously described (2, 3). The preparations of fatty acid were oxidized to CO₂, and the radioactivity measured as BaCO₃ by means of a thin mica window Geiger counter.

Liver slices from normal fed or fasted (48 hr) cats convert an appreciable amount of radioactive acetate to long-chain fatty acids (Table 1). This conversion is significantly enhanced by the addition of insulin to the incubating medium. In contrast, liver slices from depancreatized cats convert only a minimal amount of acetate to fatty acids, and this conversion is not affected by the addition of insulin to the medium. Liver slices from Houssay cats readily transform labeled acetate to long-chain fatty acids, and insulin again exerts a stimulating effect on the process.

The results indicate that under these conditions neither insulin nor the hormones of the pituitary gland are required for the synthesis of fatty acids from acetate by liver. It is likely that the pituitary gland secretes a principle which, directly, or indirectly through the mediation of some other endocrine organ, inhibits this process of fatty acid synthesis. The role of insulin in the normal organism appears to be that of an antagonist of the pituitary principle. It seems likely, therefore, that in the normal animal fatty acid synthesis requires an appropriate balance between insulin and hypophyseal activity.

² We wish to thank P. Tavormina, of Sharp & Dohme, Inc., for this sample.

Further studies are in progress to determine whether the pituitary principle can be identified with one of the recognized hormonal entities secreted by the pituitary gland.

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X-Ray Diffraction Studies of Inclusion Bodies Found in Plants Infected with Tobacco Mosaic Virus¹

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Crystalline inclusion bodies in tobacco plants infected with tobacco mosaic virus were observed as early as 1903 (1-2), but to date no conclusive evidence has been obtained concerning the nature (or chemical identity) of these bodies. Bernal and Fankuchen (3) have shown that purified tobacco mosaic virus exhibits x-ray diffraction patterns arising from the intramolecular arrangement of the atoms within the virus molecule as well as from the intermolecular arrangement of the virus molecules with respect to each other. They showed that the intermolecular spacing varied with the ion concentration and, furthermore, that the order in the gels is two-dimensional but not three-dimensional. Oster and Stanley (4) have been able to observe the diffraction of visible light in freshly prepared gels and have calculated a layer spacing of about 3,000 Å. More recently, Wilkins, Stokes, Seeds, and Oster (5) have reported optical evidence on the layering of inclusion bodies.

We decided to seek further evidence on the growth and development and on the identity and internal structure of the inclusion bodies associated with tobacco mosaic virus, by means of x-ray diffraction studies on inclusion bodies *in vivo*, supplemented by further observations under the microscope. In this paper we report preliminary results.

For the x-ray diffraction studies we used both Norelco and Hilger units, trying copper, iron, chromium, and cobalt radiations. The camera was a North-American Philips microcamera which we had modified by improving the specimen- and film-holders and by increasing the specimen-to-film distance (6). We directed the x-ray beam on single, large, rod-shaped inclusion bodies found within hair cells of diseased plants.² To date we have obtained a few diagrams from such bodies that show distinct spacings and orientation. The spacings correspond fairly closely to the strongest

¹ This work was made possible by a grant-in-aid from the American Cancer Society upon recommendation of the Committee on Growth of the National Research Council.

² The diseased tobacco plants were kindly given us by L. M. Black, of the Brooklyn Botanical Garden.

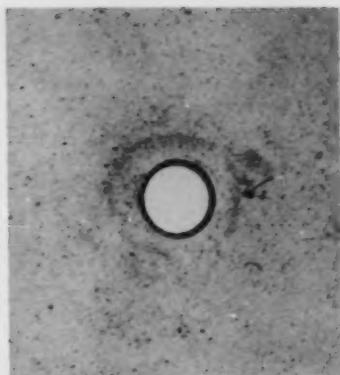


FIG. 1. Enlargement of microcamera diagram of inclusion body, taken with iron radiation. Arrow points to ring of roughly 24 Å spacing.

maxima exhibited by the intramolecular diagrams of TMV gels (3). They are too few to permit positive identification if the x-ray evidence is taken by itself; in conjunction with the circumstantial evidence reported by others (4, 5), indications are strong that the inclusion bodies consist of the virus protein. X-ray diffraction studies on these microscopic objects require highly specialized equipment and techniques. We are still improving both, and intend to report on the instrumental details at a later date. Fig. 1 shows a typical diagram. Microscopic studies are reported by one of us in the note which follows.

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Microscopic Studies of Inclusion Bodies Found in Plants Infected with Tobacco Mosaic Virus¹

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Inclusion bodies found in the hair cells and leaves of diseased tobacco plants suffering from mosaic dis-

¹ This work was made possible by a grant-in-aid from the American Cancer Society upon recommendation of the Committee on Growth of the National Research Council.

² The author wishes to thank I. Fankuchen for his interest and encouragement. The diseased tobacco plants were kindly supplied by L. M. Black, of the Brooklyn Botanical Garden. The use of the phase microscope of the National Lead Company Research Laboratory was made available by F. J. Williams, research director. Figs. 2 and 3 were prepared with National Lead Company equipment by M. Kuchner and B. Ostrofsky, of the staff of the Research Laboratory.

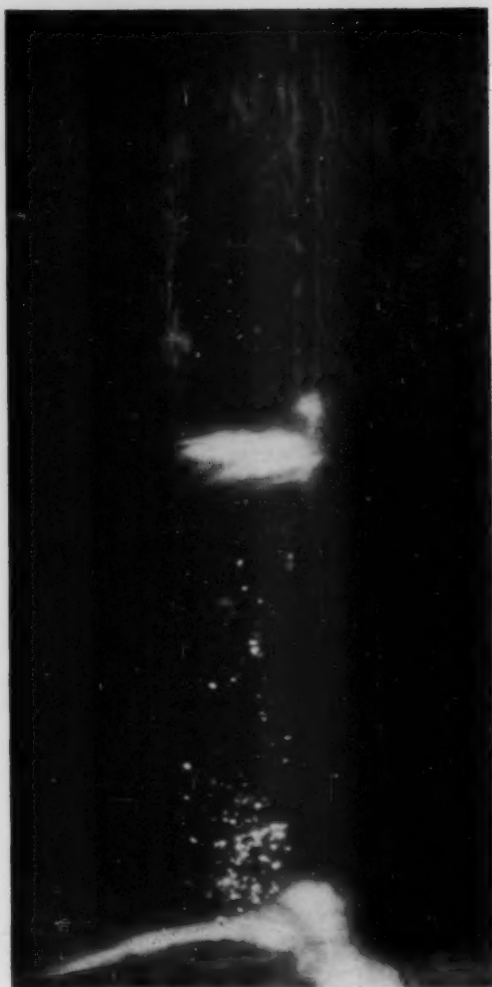


FIG. 1. Microphotograph of hair cell containing scintillating specks. Polarized light with crossed nicols; $\times 500$.

ease have been described by many authors (1-5). In connection with our x-ray studies (6) this author has made a few observations that are believed to be of general interest.

The inclusion bodies are hexagonal platelets, elongated rods, or aggregates of either form. Generally, the platelets are found in the early stages of the disease. Later platelets, aggregates of platelets, and long rods are met with simultaneously. Still later, the rods predominate.

All these forms are often found to move about within a hair cell, probably under the influence of the flow of the cell juice. They may be stable for long periods, or they may change form within a few hours. Occasionally, 2 inclusion bodies collide. When 2 plate-

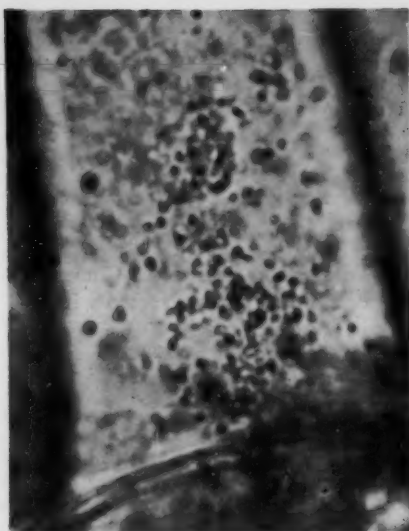


FIG. 2. Hair cell with the same specks. Ordinary light; $\times 1200$.

lets collide edge-on, they stick together and form a crystalline aggregate with more or less perfect hexagonal edges. On one occasion, the face-on collision of a small platelet with a large one could be observed. For an instant the system appeared to form a round globule, and then a new single hexagon emerged with a larger face than either parent.

Under crossed nicols, the long rods exhibit birefringence and so do the platelets when viewed edge-on. Occasionally, lively twinkling against the dark background of the hair cell was observed (Fig. 1). This twinkling is caused by very small, optically anisotropic particles which move rapidly and thereby turn themselves into and out of extinguishing positions. With a magnification of $\times 1200$ or with phase contrast equipment, these particles could be seen without the use of polarized light (Fig. 2).

The scintillating particles were first noticed at a point where a hair was growing a new side branch. Later, they were found in other hair cells on days when no large stable inclusion bodies could be found anywhere in the plant. A large inclusion body that had been selected for mounting in the diffraction camera had disappeared the following day, and no inclusion bodies could be located in those leaves that had been left on the plant. Instead, both in the hair cell that had been positioned in the camera and in the hair cells on the plant, twinkling was observed everywhere. The leaf in the diffraction camera was still in good condition and accordingly was left there another day. The following day, several inclusion bodies were found again in the positioned hair cell, but no scintillating particles were observed. Examination of the plant showed the same over-all picture.

In his paper on the spontaneous formation of struc-

tures in sols, Zocher has described strikingly similar observations (7). On standing, V_2O_5 sols tend to form ordered aggregates, and Zocher has also observed twinkling under crossed nichols. This similarity is of special interest because Zocher's ordered colloids belong to a type that has many properties in common with purified TMV solutions.

All in all, the observations reported in this paper are compatible with the hypothesis that the different large inclusion bodies and the small particles responsible for twinkling are forms of aggregation which TMV may assume inside the plant. They suggest that the conditions of stability are different for the different forms.

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Polymorphism of Pregnenolone Acetate

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In this laboratory rigorously purified samples of 5-pregnen-3 β -ol-20-one acetate from various sources showed a melting point lower than those reported by previous investigators. This behavior led us to examine the properties of this compound more carefully in order to determine whether polymorphic forms were involved.

Other workers have reported that pregnenolone acetate melts at 146°-147° when prepared from stigmasterol through 3 β -acetoxybisor-5-cholenic acid (1), and at 147°-149° when prepared through its semicarbazone after oxidation of cholesteryl acetate dibromide (2, 3). In the present work, a sample of pregnenolone prepared through selective reduction of 5,16-pregnadien-3 β -ol-20-one from diosgenin (4) was acetylated, and the crude product was crystallized from acetone. This was followed by crystallization from isopropanol, ethyl acetate, isopropanol, and acetone. The melting range did not change after the first two crystallizations. When heated from 135° at

0.5°/min, the pure material (prismatic needles, or parallelepipeds, dried *in vacuo* and powdered) partly liquefied at 144.8°-145.5°, solidified at 145.5°-146° and fused again at 147.5°-150.0°. A sample inserted at 145.5° melted almost completely, then solidified at 146°-147°, and remelted at 147.8°-150.5°. Resolidified samples showed no change below 148°, then melted at 148°-150.5°. On powdering and drying *in vacuo* at 100° or 110° no change in range of fusion was observed, although 1-4% of samples sublimed. Continued high-temperature (145°) treatment caused decomposition as shown by lowered melting points and faulty analyses. The pure material (*Anal.* Calcd for $C_{23}H_{34}O_3$: C, 77.95; H, 9.56. Found: C, 77.26; H, 9.65) showed the following specific rotations: $[\alpha]_D^{21} = +18.9^\circ \pm 0.6^\circ$ (1% in EtOH); $[\alpha]_D^{21} = +13.8^\circ \pm 0.6^\circ$ (1% in $CHCl_3$); $[\alpha]_D^{18} = +11.1^\circ \pm 0.6^\circ$ (1% in dioxane).

Further samples of pregnenolone acetate showing the same phenomenon upon melting were prepared from diosgenin (4), 3-acetoxy-bisnorcholenic acid (1), and cholesterol (2, 3). Each sample was recrystallized exhaustively from isopropyl alcohol, acetone, ethyl acetate, and finally benzene-ethyl ether (1:10) to constant melting range. Solubility analyses (5) indicated no impurity within the limits of the method. The soluble portions from the solubility analyses and the final recrystallizations were, within instrumental limitations, identical to the main crystal fractions in melting range, optical rotation ($[\alpha]_D^{20} = 10.6^\circ \pm 0.7^\circ$ in dioxane), molecular extinction coefficient at 261 $m\mu$ ($\epsilon = 42.09 \pm 0.31$, 2 mg/cc in absolute ethanol), and infrared absorption spectrum.

The semicarbazone of the purified pregnenolone acetate was prepared in quantitative yield (mp = 253°-255°C dec, inserted at 245°), and recrystallized to constant mp (256.5°-257°C) from chloroform. The pregnenolone acetate prepared by splitting with pyruvic acid (3) still exhibited the wide melting range characteristic of polymorphic forms.

On the basis of this physical and chemical evidence, the behavior upon fusion of pregnenolone acetate can be ascribed to the presence of one or more polymorphic forms.

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¹ All melting points are corrected.

Roots, herbs, leaves, and barks still used as healing agents by the contemporary Mayas have been turned over by the Knaggs Expedition to Sterling-Winthrop Research Institute for study. Headed by Nelson S. Knaggs, of Hilton-Davis Chemical Company, dye manufacturers of Cincinnati, the expedition visited Guatemala, Yucatan, and Honduras, testing new

tropical medicines developed by Sterling-Winthrop, observing Maya methods of weaving and dyeing textiles, and collecting natural-history specimens.

Chemical Industries, McGraw-Hill monthly publication, became a weekly magazine on January 20, changing its name to *Chemical Industries Week*.

Comments and Communications

The 1950 Silly Season

PART of an editorial in the *Saturday Evening Post* for November 18, 1950, entitled "The 1950 Silly Season Looks Unusually Silly," is here quoted:

One of the most astonishing episodes of the summer idiot's delight was the effort of American scientists to suppress a book, *Worlds in Collision*, by Dr. Immanuel Velikovsky. The scientists did succeed in forcing the Macmillan Company to withdraw the book, according to Doctor Velikovsky, by threatening to boycott Macmillan textbooks. Fortunately, another publisher, Doubleday and Company, took over the publication of the book, which is still going great guns. Doctor Velikovsky's offense seems to be that he writes better than most scientists and in his book expounds a theory of astronomical activity which differs widely from orthodox theories. . . .

So the orthodox scientists, forgetting about Galileo, and the long, woeful struggle of scientists, or even pseudo-scientists, to be free of dogma, acted like the authoritarians with whom they are continually in conflict. In the course of the struggle they managed to get an able book editor out of a job which he had had for many years, and the effect on the sale of the book was probably just the opposite of what the misguided book burners hoped for.

Fortunately for the publishing business, specialists in other fields are less easily hexed than astronomers. Other-wise professors of history might take an attitude toward the publishers of *Forever Amber* as stuffy as that of the scientists toward Doctor Velikovsky, his reversible sun and his capering comet. But seriously, not even a silly season ought to excuse scientists for book burning. After all, they are always the chief victims of this kind of intolerance.

We need recall only in outline the extraordinary events that attended publication of *World in Collision* last spring. First *Harper's*, then two other magazines with wide distribution, printed advance summaries of the sensational book, with impressive appraisals of the author and his "scholarly" product. *Reader's Digest* prefaced its short version with the estimate, by a literary critic, that Velikovsky's creation might well attain the distinction of Darwin's *Origin of Species*. The publisher then advertised the book as a scientific contribution, listing it in the Macmillan spring catalogue under the heading "Science," along with new books in several scientific fields. This obvious build-up of a best seller by an old and reputable publishing house brought strong protest from many of Macmillan's authors, who felt that the advertising methods violated the publisher's clear responsibility to them. Within a short time the Velikovsky book was taken over by another publisher.

First, a newspaper columnist and, later, the *Saturday Evening Post* accused "the scientists" of "ganging up" on Velikovsky and Macmillan, with unworthy motives and the use of strong-arm methods. According to the confident diagnosis in the *Post* editorial, the motives ranged from base jealousy of Velikovsky's

superiority (!) as a writer to blind dogma that would curtail freedom of expression on scientific subjects. At least by implication, scientists as a group were held guilty of collusion in unworthy behavior.

Doubtless there will be differences of opinion in selecting the most conspicuous exhibit from "the 1950 silly season." The *Post* editorial quoted above may prove to be a strong contender.

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Inaccurate Report

I SHOULD like to call to your attention that the report in *SCIENCE* (113, 341 [1951]) on the isolation of a new compound, TPN, is incorrect, due, no doubt, to an erroneous newspaper report that appeared in the *New York Times* on February 2. The *Times* science reporter got the story quite wrong.

What was isolated in this laboratory was not TPN (which has been known for years) but a new enzyme which needs TPN for activity. The enzyme seems to play an important role in the biological assimilation of carbon dioxide by animals and plants and, probably, in photosynthesis (S. Ochoa, J. B. Veiga Salles, and P. J. Ortiz, *J. Biol. Chem.*, 187, 863 [1950]). When the enzyme is added, together with TPN, to chloroplast preparations from green spinach leaves, in the presence of pyruvic acid and CO_2 , and the mixture is illuminated, pyruvic acid takes up CO_2 and is converted to malic acid. Thus a photochemical assimilation of CO_2 has been obtained in a cell-free system. A report of these experiments, carried out in collaboration with Wolf Vishniac, will shortly appear in *Nature*.

I would appreciate it very much if you would take the necessary steps to have the report in *SCIENCE* properly corrected at the earliest possible time. Also, please note that my name was misspelled.

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The Significance of pH, Ion Activities, and Membrane Potentials in Colloidal Systems

IN A recent paper in this journal Jenny *et al.* (1) have presented a new theory to explain the cause of the potential that arises across an electrically-charged colloidal membrane separating two solutions of different salt activities. They assume that the relative diffusion rates of, e.g., K^+ and Cl^- for a KCl solution are affected by the immobile charges in the membrane, the potential which arises across the membrane being

simply a liquid junction potential. In order to check their theory they first determined, by a standard method, the transference number of K^+ and Cl^- in systems comprising KCl solution and cation exchange material and found that the transference number of Cl^- was a function of the salt activity in the solution. They then described this function by an empirical equation and used this in the general equation for the liquid junction potential. This enabled them to compare data from experiments with the same membrane separating two solutions of different KCl activities with data calculated from their equation (Table 1, their paper). This procedure is not really a check on their theory, but a check of the validity of the equation they used for the liquid junction potential.

It is of interest to compare their theory with the theory for the potential across charged membranes worked out independently by Teorell (2) and Meyer and Sievers (3). This theory, which is based on the assumption of a Donnan distribution between the solution and the membrane, was later extended by the writer (4) to cover also the diffusion of salt mixtures through membranes, and the effect of the charge of the membrane on the diffusion rates and directions of the individual ions.

According to the Teorell-Meyer and Sievers theory, the potential across a charged membrane separating two solutions of the same monovalent salt (the transference numbers of the ions being the same) but of different concentrations is

$$E = \frac{RT}{F} \left[\ln \frac{\sqrt{X^2 + 4C_1^2} + X}{2C_1} - \ln \frac{\sqrt{X^2 + 4C_2^2} + X}{2C_2} \right], \quad (1)$$

which at $25^\circ C$ can be written

$$E = 25.6 \left[\sinh^{-1} \frac{X}{2C_1} - \sinh^{-1} \frac{X}{2C_2} \right], \quad (2)$$

where E is the potential in mv and C_1 and C_2 refer to the concentrations of salt in the two solutions.

X is the apparent charge concentration in the membrane and has to be found by trial and error. From the data presented by Jenny *et al.* for the membrane with Ion-X exchanger in their Table 1 (substituting concentration for activity), X is found to be 0.25. (The E -value for $a_2 = 2.323$ is not considered in the estimation of X .) The potential across the membrane can then be expressed by

$$E = 25.6 \left[3.99 - \sinh^{-1} \frac{0.125}{a_2} \right], \quad (I)$$

where a_2 is the activity of KCl which was varied during their experiment. Table 1 gives the comparison between the measured E -values taken from their paper, the E -values calculated from their equation, and the E -values calculated by the writer from Eq. (I).

The agreement between the data calculated from Eq. (I) and the experimental values is very good except for $a_2 = 2.323$. The agreement is apparently better than between the measured values and those calculated by Jenny *et al.*

There is also another theory that can be applied to explain the source of the potential, namely, the

TABLE 1

Mean activity in the solutions separated by the membrane		Calculated potential					
		Measured potential in mv	By Jenny <i>et al.</i> from their equation	By writer from Eq. (I)	By writer from Eq. (II)	(a)-(b)	(a)-(c)
a_1	a_2	(a)	(b)	(c)	(d)	(a)-(b)	(a)-(c)
0.00463	0.00902	18.0	17.7	16.9	17.4	0.3	1.1
	.0441	53.7	53.7	57.1	55.2	0.0	-3.4
	.296	91.7	85.2	91.6	91.7	6.5	0.1
	0.432	96.5	89.3	94.8	97.0	7.2	1.5
	2.323	113.0	102.0	101.2	113.2	11.0	11.8
							-0.2

theory of the diffuse double layer of ions at a charged surface. The potential difference between a charged surface and a point in the solution far from the surface can be derived from the Poisson-Boltzmann differential equation and reads ($T = 298^\circ C$).

$$E = \frac{51.2}{\kappa} \sinh^{-1} \frac{Z}{\sqrt{c}}, \quad (3)$$

where Z is a constant linearly dependent on the charge density of the surface, κ is the valency of the ions neutralizing the surface charges, and c is the molar concentration of the salt solution. The potential corresponding to the system given in Table 1 is then expressed by

$$E = 51.2 \left[\sinh^{-1} \frac{Z}{\sqrt{a_1}} - \sinh^{-1} \frac{Z}{\sqrt{a_2}} \right]. \quad (4)$$

The constant Z has to be found by trial and error and, for the data given in Table 1, is 0.39. For comparison, the data calculated from the equation

$$E = 51.2 \left[2.46 - \sinh^{-1} \frac{0.39}{\sqrt{a_2}} \right] \quad (II)$$

have also been included in Table 1. The agreement between these and the observed values is very good for all values of a_2 .

There is a fundamental difference between the theory of Jenny *et al.* and those applied by the writer. In the first theory the properties of the membrane are described by a quantity τ , the transference number of the anion; this quantity is not a parameter but a function of the activity of the salt solution. In the alternative theories, the same properties are described by a quantity X , the apparent charge activity of the membrane, or Z , which is linearly dependent on the charge density of the membrane surface; these quantities are real parameters, independent of the activity of the salt solution. From this point of view the Teorell-Meyer and Sievers theory and the writer's theory are to be preferred, and they have also the advantage of enabling the magnitude of the potential at each boundary surface to be calculated, which is not possible from the Jenny theory.

Jenny *et al.* then apply their theory to the determination of pH in colloidal suspensions of charged particles by regarding the suspensions as membranes. It is well known that the pH measured in such suspensions differs from that measured in the filtrates. This effect has been attributed to the influence on the reversible electrode of the ions in the swarm around the charged particles, and has been called the suspension effect by Wiegner and Pallmann (5). From the theory of Jenny *et al.* and their further experiments, two alternatives can be given: (1) There exists a suspension effect, and as a consequence of this no appreciable "membrane" or liquid junction potential can occur at the point of contact between the KCl bridge and the suspension. (2) There is no suspension effect; the difference in pH between the suspension and its filtrate is due to the liquid junction potential at the point of contact between the KCl bridge and the suspension.

They seem to prefer the second alternative which, however, is really disproved by their data on the transference number of Cl⁻ at different concentrations in the Ion-X exchanger membrane. From Fig. 1 in their paper it is seen that τ increases with increasing concentration of KCl.

According to the alternative theories presented here, the "membrane" potential at the point of contact between the KCl bridge and the suspension must be comparatively small (insignificant according to the Teorell-Meyer and Sievers theory), provided a concentrated solution of KCl is used in the bridge. Differences in the pH of the suspension and its filtrate must accordingly be attributed to a suspension effect, an explanation that is more satisfactory from a kinetic point of view.

The problem of the determination of ion activities in colloidal suspensions has recently been treated in a paper by the writer (6) and can be summarized briefly as follows: In any system of ions subjected to thermal motion, the electrochemical potential of an ion at equilibrium is the same at every point in the system. This is a thermodynamic principle from which the Donnan equation, for example, can be derived. The principle can be interpreted in this way: If, in a system of ions at equilibrium, the osmotic activity of an ion at point *a* differs from that at point *b*, then the electrical potential at *a* must differ from that at *b* in such a way that the work done in transporting an ion from *a* to *b* must be equal to the work gained in transporting the corresponding charges from *a* to *b*. The ratio of the osmotic activities of an ion at *a* and at *b* can then be calculated from the difference in the electrical potential between the points. From this it can be shown that, provided the liquid junction potential is negligible, the pH measured in a colloidal suspension of charged particles in the ordinary way represents the pH at the point of contact between the KCl bridge and the suspension, and not at the point of contact between the reversible electrode and the suspension.

Of course the practical importance of this con-

clusion rests on the assumption of a suspension effect, which has also been discussed by the writer (6). If the ions neutralizing the charges at the surfaces of the colloidal particles are subjected to thermal motion, thus forming a swarm, a suspension effect will occur, especially as the particles themselves are also subjected to thermal motion. There are many indications that a swarm, or a diffuse double layer, as it is also called, exists around charged particles. (This, of course, implies that the concept of matter is based on mass, charge, etc.). It is, for example, well known that most exchange reactions on colloidal particle surfaces take place rapidly. If, in addition to the electrical forces, the ions at the particle surfaces were also held by other and much stronger forces, their thermal motion would be practically zero and the exchange reactions very slow.

There are also many phenomena in colloid chemistry that have been successfully explained by theories based on the assumption of a diffuse swarm of ions around the individual particles. The stability of lyophobic colloidal suspensions, for example, is very difficult to explain without assuming the existence of a diffuse double layer that creates repelling forces between the particles (7). The negative adsorption of anions in clay mineral suspensions, treated by Schofield (8), and the relation between the water content and the "osmotic" pressure in a bentonite gel recently derived by the writer (9), are both experimentally verified theories based on the assumption of a diffuse double layer.

If, on the other hand, it is assumed that the thermal motion of the ions neutralizing the charges at the particle surfaces is insignificant—i.e., they do not influence the potential of a reversible electrode—it would be extremely difficult to explain the variation in the apparent transference number of Cl⁻ with the concentration of salt in the experiments by Jenny *et al.*

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Errata

Through an accident that occurred while the issue was on the press, in some copies of *SCIENCE* for March 30, page 361 is misnumbered 261. The article by R. J. Hickey and P. H. Hidy begins on this page.

Book Reviews

Space-Time Structure. Erwin Schrödinger. New York: Cambridge Univ. Press, 1950. 119 pp. \$2.75.

Those already familiar with any of the publications of this author will reach eagerly for this new publication of a great physicist, and they will not be disappointed. Throughout the book we find Schrödinger's familiar informal style; here we find those little details and aids to the memory in the exposition of the material by which the author manages to make the subject clear to the student. Here and there the text takes the form of a lecture, but even where this is not directly the case, the style of the book is so interesting that one has the feeling of being spoken to personally.

The general purpose of the book is to give (for those having some superficial familiarity with special relativity theory) a clear and up-to-date picture of the mathematical fundamentals of general relativity theory. Thus, this is a book on geometry rather than on physics. Possible physical applications of these geometric considerations are scarcely touched. No discussion is given of applications of the theory of gravitation to planetary motion or to other effects that form the experimental backbone of general relativity theory. Nor is there a discussion of cosmological problems, nor one of the place of spinors in general relativity. One could therefore wish for a second volume from this author dealing in the same lucid and entertaining way with these and other elaborations and applications of the theory.

Space-Time Structure is indeed a mere introduction to the subject—an excellent and easy-to-understand introduction, at that, which one can in good conscience give to individual students wanting to get acquainted with the geometrical methods of general relativity. But this book is equally important for those who studied the subject long ago. For them, it is not only a wonderful refresher but has an entirely new approach. Its originality lies in not following the historical evolution, but putting the affine connection ("principle of parallel displacement") ahead of a metric, instead of letting it follow. The parallel displacement is indeed the basis for the underlying idea of the theory of gravitation that a particle will follow in space-time the "straightest line possible." This affine connection by itself then does already provide a measure along the geodesic lines themselves. A general metric is introduced later for enabling us to take over special relativity theory for small regions surrounding arbitrary points in space-time. Even postulating the identity of both measures along the geodesics, one finds the equality of the affine connection to the Christoffel brackets only under two further special assumptions.

In the last chapter, Schrödinger reports on some generalizations of Einstein's original theory, such as the Einstein-Straus theory. Interesting, too, is the

purely affine theory discussed on the last few pages of the book; in which a "metric" is derived from the affinity, instead of the other way around. In the discussion, a reference is given to some of Schrödinger's own recent work on this subject.

The reviewer regrets that no more references to further and original literature have been given. The lack of an index is less serious, as the study is brief and has a satisfactory table of contents. (The author probably thought that sufficient indices already appear in the equations!)

Many physicists will criticize the way in which Schrödinger considers his relation (11.11) between the gravitational field and the energy tensor T_{ik} of matter (and light). On page 99 it is stated that this is to be regarded as a definition of T_{ik} . If this is correct, then T_{ik} would not depend on matter field variables at all and, in a quantum theory of matter, would be independent of the numbers of particles and photons present. But the whole importance of Eq (11.11) is the part which Schrödinger denies it, viz., telling us how the gravitational field is influenced by the presence of matter. For, although the left-hand member of (11.11) depends solely on the gravitational field, its right-hand member T_{ik} can and should be expressed in terms of the components of the matter and light field. Such definition of T_{ik} cannot follow from a discussion of the g_{ik} field alone, but requires such considerations of the matter field as the reviewer has given in *Physica* (7, 449, [1940]). A similar argument applies to the equation $\text{div } E = 4\pi\rho$ of electrodynamics, which is usually not even maintained as an identity but is replaced by an auxiliary condition imposed on the state vector.

Some other criticisms are the following:

The footnote on page 36 overlooks the special case $A B_{;k} = 0$, $AB \neq 0$. On page 41 it might have been added that one can enforce symmetry of the affinity by postulating the possibility of constructing arbitrary infinitesimal parallelograms. On pages 98 and 100, the statement that in general one should expect fourth order Hamiltonian derivatives of the curvature scalar density is incorrect, as this density is of only second degree in the differentiation operator ∂_k . Variation cannot increase this degree. Therefore, the reasons given on pages 100–101 for this missing of higher than second order derivatives are superfluous. On page 100, a short discussion of "free" scalars and vectors would have been welcome in connection with the problem of the possible "invariant meaning" of any three-dimensional volume integrals of components of vectors or tensors.

The number of misprints is relatively low. Some trivial printing errors appear in formulas on pages 6, 24, 25, 30, 31, and 100. The word "vanish" in the footnote on page 15 should read "are unity." In Eq (9.7), read k_i or k_k instead of k_l in the Christoffel bracket symbol. In Eqs (9.8) and (9.10) factors $-\frac{1}{2}$ should be replaced by factors $+\frac{1}{2}$. This also affects the sign of Γ in the last equation on page 67. Line 23 on page 68 is confusing by its brevity.

On lines 12 and 15 of page 76, read "but impossibly" instead of "or possibly." On pages 104-105 the use of the indices of T^m_n and of the asymmetric tensor t^m_n is contrary to that in Eq (11.21).

As for the notation: The arguments on page 7 in favor of x_k instead of x^k and on page 45 for c_a and h_{ab} instead of c^a and h_p^a are not very convincing. This notation leads to atrocities such as $(dx)^k = d(x_k) \neq (dx)_k = g_{ki}(dx)^i$, and it fails to show the correct vector character of the local and world coordinate differentials, which would be better shown by a notation using $dy^a = h_p^a dx^p$.

Also, the use of $A_{;k}$ and $A_{.k}$ is hard on the eye. $\nabla_k A$ and $\partial_k A$ would not have required use of a magnifying glass. The tensors on page 23 could then have been written in the easier-to-memorize forms $\partial_{[k} A_{i]}$, $(\frac{1}{2}) \partial_{[i} \phi_{k]}$, and $(\frac{1}{2}) \partial_{[m} A_{k l]}$, in which less harm is done when a student inadvertently tries to apply these theorems to tensors lacking the required antisymmetry.

All these little details do not alter the fact that this book is a very welcome and important contribution that deserves wide attention.

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Bees: Their Vision, Chemical Senses and Language.

Karl von Frisch. Ithaca, N. Y.: Cornell Univ. Press, 1950. 119 pp. \$3.00.

Professor von Frisch, of the University of Munich, has crystallized in delightfully clear English his 40 years of monumental research in interpreting the senses and language of the honeybee. His book will appeal to scientists, teachers, and laymen. Von Frisch has successfully reduced a complex subject to a clear, easy-reading text. He exemplifies scientists who place clear thinking and perseverance ahead of great physical resources for successful research. Students who expect to enter scientific fields will gain from it a desirable attitude of mind.

Bees are shown to have a sensitivity range between orange-yellow and ultraviolet or to light waves between 650 and 300 mμ. The response of bees to the influence of floral colors and color patterns is clearly demonstrated. They respond more strongly to their olfactory sense and to taste than to color, yet these senses collectively affect their behavior pattern. Bees distinguish between sweet, sour, salt, and bitter, although their threshold of tastes for these differ quite strongly from those of man.

The "language of bees" is shown to involve sensory behavior in respect to color or light quality, odor and taste perception, and the well-known bee dances. The author shows how these dances serve to communicate to other members of the colony that not only is food available in the field, but also what plant species is producing it, in what direction from the hive these plants are to be found, and how far the bees must travel to reach this food source.

The author was able to establish that bees apparently have the faculty of analyzing the polarized

light in the sky. When they perceive a point of light from any direction in the sky, they can orient direction just as accurately as when they see the sun. The author discusses in the appendix the structure of the ommatidia in the compound eye in relation to an artificial eye he constructed from triangular pieces of polaroid to simulate the 8 visual cells observed in a bee ommatidium.

Students of bee behavior will recognize the general validity of the basic conclusions drawn from the experiments, for they have all observed many situations that fit this behavior pattern. Von Frisch would be the first to assert that there is much more to learn about the sensory mechanisms and their associations in the now well-established principle that bees have a positive language.

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Muscular Contraction: A Topic in Molecular Physiology.

W. F. H. M. Mommaerts. New York-London: Interscience, 1950. 191 pp. \$4.20.

The author of this monograph has presented an account of recent developments in the field of muscle biochemistry, emphasizing description of the actual experimental discoveries and discussion of the immediate interpretations of these discoveries.

The book begins with an outline of muscle metabolism which presents a very clear picture of the history and present status of carbohydrate metabolism and high-energy phosphate bonds in supplying energy for muscular contraction. Subsequent chapters present rather exhaustive accounts of work on the structure, activity, and interrelationships of the muscle proteins. Such topics as the structure of the muscle fibril, molecular sizes and shapes of muscle proteins, and viscosity and birefringence of flow are discussed. Experimental methods and results of the various investigators are described, and interpretations are made both from the data of that investigator alone and from correlation of all work presented in that section of the text.

Although at first glance the book may appear to be a duplication of one or more of the monographs of Szent-Györgyi, there is actually little overlapping. Szent-Györgyi's summaries are chiefly concerned with his own work, whereas this monograph devotes most of its space to the work of others, referring the reader to Szent-Györgyi for details and discussion of the theoretical background of his work.

The book is written so that a person seeking an introduction to the field can obtain it without wading through the pages of detail which will, however, be of great value to those who must for various reasons be more familiar with the latest developments of the problem.

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News and Notes

Scientists in the News

Reginald M. Atwater, executive secretary of the American Public Health Association, was recently elected to honorary fellowship in the Society of Medical Officers of Health of Great Britain.

Katharine B. Blodgett, of the General Electric Research Laboratory at Schenectady, received the 1951 Francis P. Garvan Medal honoring women in chemistry at the American Chemical Society's meeting in Cleveland. Dr. Blodgett is an authority on surface chemistry, and her findings have led to the development of "invisible" glass and thickness gauges that can detect a variation of one millionth of an inch. Her medal address, delivered before the Division of Physical and Inorganic Chemistry, dealt with "Interference Colors Reflected by Thin Films."

Maurice L. Brashears, Jr., of the Mineola, N. Y., office of the Ground Water Branch, Water Resources Division, USGS, has been assigned as a visiting expert consultant on water supplies to SCAP and the Japanese government. Mr. Brashears expects to be in Japan for several months. **Norbert J. Lusczynski** will be acting engineer in charge of the Mineola office during Mr. Brashears' absence. **Theodore Arnow** left Mineola on assignment to the Trust Territory. He will work especially with the Navy's program for the investigation of water supplies in the islands.

The Atomic Energy Commission has appointed **John C. Bugher** deputy director of the Division of Biology and Medicine. Since 1938 Dr. Bugher has been a member of the staff of the International Health Division of the Rockefeller Foundation, engaged in research and control of various infectious diseases, particularly yellow fever in Africa and South America.

C. Scott Fletcher, president of Encyclopaedia Britannica Films, Inc., has resigned as head of the firm to join the Ford Foundation.

Robert P. Gilbert, Chicago physician, has joined the Northwestern University Medical School faculty as director of the teaching program at Cook County Hospital. He will direct the course work conducted at the hospital by the Medical School's Department of Medicine and will continue his research on heart ailments.

Jack C. Greene, of the Atomic Energy Commission, has been appointed a consultant on radiological instruments in the Health Services and Special Weapons Defense Division of the Federal Civil Defense Administration. Mr. Greene joined the AEC in 1947, working as assistant chief of the Radiation Instruments Branch, which is responsible for the over-all coordination of radiation instrument development, as well as liaison with instrument manufacturers.

Folke Henschen, of Stockholm, has accepted a chair of pathology at the University of Cairo, with the title of visiting professor. He will teach for a six-month term.

George M. Hocking, professor of pharmacognosy and pharmacology at the University of New Mexico, has been given a temporary appointment as forestry officer in FAO. He will serve as consultant to Pakistan on matters relating to the production of crude drugs from wild and cultivated plants.

Yacko Kawai, 29-year-old doctor from Tokyo, is in this country to study for a year at the Institute of Physical Medicine and Rehabilitation of the New York University-Bellevue Medical Center. A graduate of the Women's Medical College of Tokyo, Dr. Kawai came to the U. S. on the \$2,000 Harriet Ford Griswold Award of Kappa Kappa Gamma, national women's college fraternity. She is on leave of absence from the First National Hospital of Tokyo. A specialist in gynecology, Dr. Kawai also belongs to the Japanese affiliate of the International Society for the Welfare of Cripples. Among her aims is the establishment in Japan of a training program for the rehabilitation of handicapped persons.

The American Association of Candy Technologists will present the Stroud Jordan Award for outstanding contributions in the field of candy technology to **James A. King**, vice president, Nulomoline Division, American Molasses Company. This award, established in commemoration of the contributions made by the late Stroud Jordan to the confectionery industry, and made available through the cooperation of The American Sugar Refining Company, will be presented during the annual meeting of the AACT, June 5, at Chicago.

Morton F. Leopold, who has been in charge of motion-picture production for the Bureau of Mines for more than three decades, has been presented a gold medal and a citation for distinguished service. Mr. Leopold joined the Bureau a few months after its creation in 1910. He developed the pattern of cooperative government-industry film production that has enabled the bureau to build up the largest free loan library of educational motion pictures of its kind in the world.

S. Allan Lough, who was chief, Radioisotopes Branch, Isotopes Division, AEC, has been named assistant chief, Isotopes Division. In his new position he will assist Paul C. Aebersold in the over-all operation of the commission's isotope distribution program. Dr. Lough succeeds **Nathan H. Woodruff**, who is now serving as technical assistant to the manager of the commission's Oak Ridge Operations.

The University of Chicago Press has announced the election of **Franklin C. McLean** as secretary of the

University of Chicago Committee on Publications in Biology and Medicine. Dr. McLean is professor of pathological physiology at Chicago, as well as director of the Atomic Energy Project at the university's toxicity laboratory. The committee, which is responsible for the selection of works in biology and medicine for publication by the University of Chicago Press, is composed of Emmet B. Bay, Lowell T. Coggeshall, Lester R. Dragstedt, Thomas Park, and William H. Taliaferro.

Carl Neuberg, visiting professor at the Polytechnic Institute of Brooklyn, has been appointed associate with the rank of professor at the New York Medical College Flower and Fifth Avenue Hospitals.

Ralph M. Patterson, of the University of Michigan Medical School, has been appointed head of the professional staff at the new Columbus Receiving Hospital in the Ohio State University Health Center, and professor of psychiatry in Ohio State's College of Medicine. Calvin L. Baker, commissioner of mental hygiene in Ohio, has been designated to supervise the institution for the Department of Public Welfare. The 140-bed receiving hospital, now nearing completion, is designed for the treatment of neuropsychiatric patients and is to be operated in connection with the medical college at Ohio State.

Kenneth Sanborn Pitzer, AEC research director, received from alumni of the University of California the "Alumnus of the Year" award for his outstanding achievements in 1950. Dr. Pitzer received his Ph.D. at the university in 1937 and became full professor of chemistry in 1945. In recognition of his achievements in the field of thermodynamics, he was awarded the Precision Scientific Company Award in Petroleum Chemistry in 1950. Dr. Pitzer was appointed to the AEC post early in 1949, to implement the present program of the commission and to initiate new fundamental research.

Arth O. Poulsen, geologist and mining engineer with the Geological Survey of Norway, is in the U. S. under the auspices of ECA for a two-month study of extraction, refining, and use of mica and nepheline. Mr. Poulsen's program provides for the study of methods used by the Bureau of Mines and the U. S. Geological Survey.

Miriam Reiner, who was senior assistant chemist in the Department of Chemistry, Mount Sinai Hospital, New York, has been appointed director of the Chemical Laboratory of Gallinger Municipal Hospital, Washington, D. C. She will continue her research on the electrophoresis of serum proteins.

As Sigma Xi national lecturer George Scatchard, of MIT's Chemistry Department, has been lecturing on the properties of blood and plasma substitutes that make them effective for serving their function in the body. Dr. Scatchard has presented the results of his research before more than 25 Sigma Xi chapters and clubs.

John C. Sheehan, associate professor of organic chemistry at MIT, received the \$1,000 American Chemical Society Award in Pure Chemistry, financed by the professional chemical fraternity Alpha Chi Sigma, during the Boston session of the Society's 119th national meeting. Dr. Sheehan is best known for his part in the research leading to the synthesis of penicillin, and for his share in developing the Bachmann process for preparing the high explosive RDX. Actual discovery of RDX was made by Werner E. Bachmann, professor of chemistry at the University of Michigan since 1925. Dr. Bachmann, 49, died suddenly on March 22 in University Hospital, Ann Arbor.

The Leopold Memorial Medal for service to wildlife conservation, named after the University of Wisconsin's famed conservationist, the late Aldo Leopold, was awarded to Carl D. Shoemaker of Washington, D. C., at the annual banquet of the North American Wildlife conference in Milwaukee. Mr. Shoemaker, second recipient of the Leopold medal, given annually by the Wildlife Society, is editor of *Conservation Report*, a publication of the National Wildlife Federation, and he has also been editor of *Conservation News Service* for the National Resources Council of America. He edited the *Status of Wildlife in the United States*, a senate document widely used as a reference work for wildlife, soils, forests, and water.

Lyndon F. Small, of the National Institutes of Health, has been appointed chief of the Laboratory of Chemistry in the National Institute of Arthritis and Metabolic Diseases. He succeeds Claude S. Hudson who retired last month. Dr. Small, editor-in-chief of the *Journal of Organic Chemistry*, has been chief of the Section on Chemotherapy.

Royal W. Sorensen, professor emeritus of electrical engineering at Caltech, has been notified of his election as an honorary member of the Institute of Electrical Engineers of Japan. The only other living honorary member of the organization is Irving Langmuir. His certificate of membership will be delivered by Matsujiro Oyama, dean of the Faculty of Engineering, Tokyo University, and past president of the IEEE, during his current visit to the United States as a member of the Joint Mission of Education and Research. The IEEE was founded in 1888 and now has a membership of 12,000. It is one of the leading Japanese engineering institutes.

J. Robert Van Pelt, mining engineer and research executive of Columbus, Ohio, has been named president of the Montana School of Mines at Butte, succeeding the late president, Francis A. Thomson. Dr. Van Pelt has been on the staff of Battelle Memorial Institute since 1945.

Claude W. Wardlaw, professor of cryptogamic botany at the University of Manchester, has been appointed Prather lecturer in biology at Harvard University for the spring term of 1950-51. During the last three weeks of April, he will give a series of seven public lectures on "Morphogenesis in Plants."

Colleges and Universities

Expansion of the science curriculum at **Brandeis University**, which will begin its fourth academic year in September, will allow several faculty appointments in general physiology, embryology, genetics, vertebrate zoology, and a general education course in biology. In addition, a number of teaching fellowships in physics, chemistry, and biology will be available. Inquiries may be addressed to Chairman, School of Science, Brandeis University, Waltham, Mass.

The **University of Bridgeport** will hold a workshop in intergroup relations July 30-August 15, designed for teachers, educational administrators, social workers, and lay leaders. The Bridgeport public schools and the state Department of Education are cooperating agencies.

Duke University will hold the first of a series of Science Teachers Laboratory Conferences July 23-27 in two sections, biological and physical. Work will feature experiments that may be performed in any high school with the usual equipment available. Paul H. Clyde is director of the Summer Session. The **School of Medicine and Duke Hospital** will offer a month's course (July 2-July 28) in medical mycology, under the direction of Norman F. Conant, to whom inquiries should be directed.

Kansas State will offer for the first time work leading to the Ph.D. degree in agronomy and in applied mechanics, beginning June 1. The Agronomy Department, of which Harold E. Myers is head, has a research farm near the Manhattan campus and acreages at five branch experiment stations, plus wind, soils, and plant research laboratories. C. H. Scholer, head of the Department of Applied Mechanics, is an authority on concrete, and is in close touch with the work of the Portland Cement Association, the bureaus of Reclamation and Public Roads, and the Army Engineers.

MIT will survey the theory and applications of servomechanisms and system engineering in a special course August 20-31. Industrial applications will be stressed, according to Donald P. Campbell, who will be in charge. Another special summer course will be in the principles of textile research, July 2-27. Edward R. Schwarz will be in charge. Information on summer sessions may be obtained from Walter H. Gale, Room 3-107, MIT, Cambridge 39.

The **University of Michigan's Survey Research Center** began a study this month at the Maytag Company, Newton, Iowa, under the direction of Gerald Mahoney. Factors related to job satisfaction and work attitude of approximately 4,000 workers, including first-level supervisors, will be covered. Results will be available in November.

The **State University of New York College of Medicine**, Syracuse, and the **Syracuse University School of Nursing** will offer a workshop in tuberculosis

nursing July 30-August 10. The course is designed to give public health, institutional, and other eligible graduate nurses an understanding of the public health and epidemiological aspects of tuberculosis control.

The **Nursery Training School of Boston**, which is affiliated with Tufts College, will offer a special course, "Implementing the Mid-Century White House Conference," July 26-August 2, and a tryout course for students considering entering the field of early childhood education. The regular summer courses will also be given. Address Katherine J. Jones, 355 Marlborough St., Boston 15, for further information.

Eight Germans from the Western Zone began a nine-week study of state and city lawmaking practices at **Ohio State** April 2. The visit is sponsored by the High Commissioner for Germany and the Department of State, and administered by the Governmental Affairs Institute. The first four weeks, to be spent at Columbus, will be directed by Harvey Walker of OSU's political science faculty. Fifth and sixth weeks will include visits to Cincinnati, Louisville, Frankfurt, Nashville, Knoxville, and the TVA. After another week in Columbus, the party will spend two weeks in Washington in a study of the democratic process as exemplified in the Congress. Two similar groups are scheduled to visit the U. S. later this spring and summer.

The **University of Rhode Island**, in cooperation with the Woods Hole Oceanographic Institution, is offering a graduate training program in biological oceanography and marine fishery biology, under the general supervision of Charles J. Fish. A limited number of students are enrolled in alternate years; the next class, which will enter in September, will spend the first year in Kingston and at Narragansett Marine Laboratory. The second year may be spent either at Woods Hole or at Narragansett. Five fellowships of \$1,200 per year are available. Address applications to the Director of Admissions, University of Rhode Island.

Wayne University College of Education will give up to eight hours of credit for a ten-week field trip that includes travel through England, France, Western Germany, and eight other European countries. Teachers, students, and professional people are eligible and should apply at once to William Reitz, professor of education, who will conduct the tour. The group will leave from New York on June 23 and return September 2.

The **West Virginia University Biological Expedition** will offer field courses in general botany and zoology to undergraduate and graduate students, both courses running concurrently June 7-July 17. Work is done from several camps set up at different locations in the state. The botany course will be conducted by Herald L. Bennett, zoology by Leland H. Taylor, director of the expedition. Dr. Taylor, Department of Biology, will supply further information.

In the Laboratories

Hercules Powder Company, through its English subsidiary, has entered into an agreement with James Nelson Limited, of Lancashire, and Erinoid Limited, of Stroud, Gloucestershire, for the production of cellulose acetate in England. A modern plant under construction in Lancaster will supply the compound for these producers of rayon and plastics as well as to other industrial consumers in Great Britain and elsewhere abroad.

Johns-Manville Corporation has begun the construction of a new building at its research center near Manville, N. J., to expand its development of substitutes for critical materials and other defense work, including jet aircraft blanket insulations, high-temperature gaskets and seals, filters for radioactive dusts, improved fireproof clothing, and heavy-duty friction materials.

The M. W. Kellogg Company, refinery and chemical engineers, will act as over-all project managers of a modern gasoline-from-coal synthesis plant to be constructed in South Africa in the near future. Using the Kellogg Synthol Process, the plant will be built for South African Coal, Oil and Gas Corporation Ltd., along the Vaal River, near Coalbrook, Orange Free State, 40 miles south of Johannesburg. Kellogg has recently placed in operation at Bahia the first cracking refinery in Brazil, for Refinaria Nacional de Petroleo, S. A.

Foster D. Snell, Inc., 30-year-old New York City firm of consulting chemists and engineers, has added William Kanninen, A. Haldane Gee, and Irving Seidenberg to the technical staff. Mr. Kanninen will be in charge of the Food Technology Department carrying out work on vitamin enrichment of foods, food preservation, antioxidants, and food packaging. Dr. Gee has been appointed director of bacteriology and toxicology, and will supervise toxicity tests on animals and humans, and bacteriostatic, fungistatic and antiseptic tests. Mr. Seidenberg has been appointed chief bacteriologist. The firm has just opened new offices and laboratories at Bainbridge, N. Y., where the Supplee Division will maintain a rat colony and assay vitamin D for dairies in the district.

Tracerlab, Inc., manufacturer of nuclear instruments and synthetic radioactive compounds, has taken over **The Kelley-Koett Manufacturing Company**, of Covington, Ky., and Cincinnati. The 51-year-old x-ray equipment firm also manufactures instruments for the detection and measurement of radiation.

A citation for distinguished public service was presented to Ernest H. Volwiler, president of **Abbott Laboratories**, by the Association on American Indian Affairs at an exhibition in New York City of 30 documentary paintings illustrating Indian health and medical needs. Abbott commissioned four prominent American artists in 1949 to make a survey of the Indians' plight. The presentation of a scroll carrying

the citation was made to Dr. Volwiler by Maria Tallchief, noted Osage ballerina, at a preview of the paintings in the Sherry-Netherlands hotel.

The Army Quartermaster Department will build an 11-million-dollar research laboratory on a 20-acre site at Natick, Mass., about 15 miles from Boston. Principal fields to be investigated will be food and containers, mechanical products, textiles, clothing and footwear, environmental protection, chemicals and plastics, and fuels and lubricants.

Chicago Research Group has acquired an exclusive license, with right to grant sublicenses, under the Hesler and Behrman U. S. Patent No. 2,415,558, which covers a process using anion-exchange resins for purifying solutions of organic acids containing as impurities relatively small amounts of stronger inorganic acids such as sulfuric or hydrochloric acid. Correspondence regarding sublicenses should be addressed to Chicago Research Group, 9 S. Clinton St., Chicago 6.

Harvard is beginning the construction of a new laboratory building, to be called the Gordan McKay Applied Science Laboratory in honor of the New England engineer and inventor. It will be devoted to advanced study and research in engineering and applied science. Also to be built this spring is Allston Burr Lecture Hall, to provide additional lecture halls and conference rooms for the expanded general education courses in the humanities and the social and natural sciences.

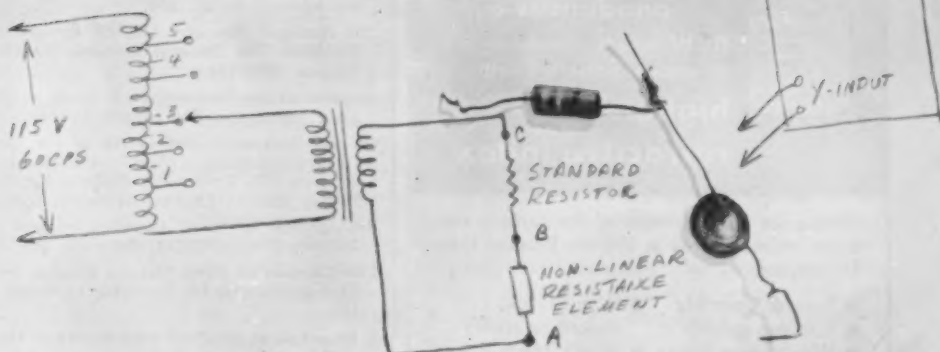
Chas. Pfizer & Co. have begun the commercial production of crystalline Vitamin A Acetate at their new plant in Groton, Conn. It is expected that the plant will be able to produce 50% of the total U. S. civilian and military need for the vitamin. Pfizer claims that their product shows no substantial deterioration when exposed to air at high temperatures for 1,200 hours, approximately equivalent to storage for 3 years under normal conditions.

The Statistical Laboratory of **Iowa State College** has available several graduate assistantships in statistics, beginning spring and fall quarters, 1951, and paying \$1,125 for 9 months. Interested, qualified students are invited to apply as soon as possible.

Armour & Company began building a new blood-processing plant at Fort Worth last month, in which the Armour Laboratories will produce dried human blood plasma under an Army contract. The only such plant in the Southwest, it will be expected eventually to handle up to 15,000 pints of blood a month. There are no plants nearer than Los Angeles and Indianapolis.

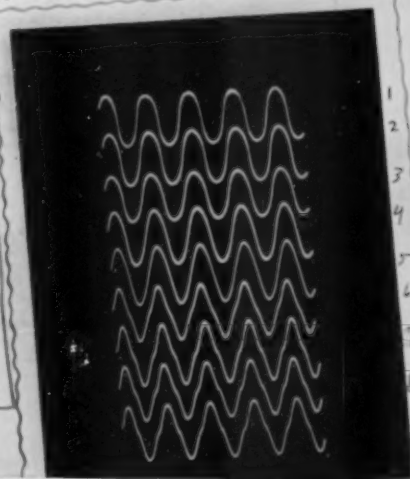
The Divisions of Tuberculosis and Chronic Disease of the Public Health Service have been consolidated. The new division will be called the **Division of Chronic Disease and Tuberculosis**, and will be headed by R. J. Anderson.

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Readers' Guide to Periodical Literature (50th Anniversary Issue). Vol. 51, No. 1. The H. W. Wilson Co., New York. March 1951.

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- Apr. 19-21. American Philosophical Society (Annual). Philadelphia.
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- Apr. 20-21. College of American Pathologists (South Central Regional). The Shamrock, Houston, Tex.
- Apr. 20-21. Symposium on Fundamental Cancer Research of the University of Texas M. D. Anderson Hospital for Cancer Research (Annual). The Shamrock, Houston, Tex.
- Apr. 20-21. Nebraska Academy of Sciences, University of Nebraska, Lincoln.
- Apr. 21. South Carolina Academy of Science (Annual). University of South Carolina, Columbia.
- Apr. 21. Biological Conference. Rhode Island State College, Kingston.
- Apr. 21-May 6. Liège International Fair for Mines, Metallurgy, and Mechanical and Electrical Engineering. Liège, Belgium.
- Apr. 22-26. American Ceramic Society. Palmer House, Chicago.
- April 22-27. Navy Industrial Health Conference. Chalfonte-Haddon Hall, Atlantic City.
- Apr. 23-24. Industrial Accident Prevention Association (Annual). Royal York Hotel, Toronto.
- Apr. 23-25. National Academy of Sciences. Washington, D. C.
- Apr. 23-27. Health Congress. Southport, Eng.
- Apr. 24-25. American Venereal Disease Association and National Institutes of Health Symposium on Advances in Luetic Control. Federal Security Building, Washington, D. C.
- Apr. 25. Adelphi College Vocational Guidance Conference. Adelphi College, Garden City, N. Y.
- Apr. 26-28. American Physical Society, Division of High Polymer Physics. Washington, D. C.
- Apr. 27-28. National Speleological Society (Annual). Charleston, W. Va.
- Apr. 27-28. Midwestern Psychological Association. The Drake, Chicago.
- Apr. 27-28. Georgia Academy of Science, Earth Science Division. University of Georgia, Athens.
- Apr. 27-28. West Virginia Academy of Science (Annual). Marshall College, Huntington.
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- Apr. 28. American Psychosomatic Society (Annual). Chalfonte-Haddon Hall, Atlantic City.
- Apr. 28-May 20. International Textile Exhibition. Lille, France.
- Apr. 29-May 3. American Association for the Advancement of Science (Southwestern Division). El Paso.
- Apr. 29-May 3. Federation of American Societies for Experimental Biology (Annual). Cleveland.
- Apr. 30-May 2. American Geophysical Union (Annual). National Academy of Sciences, Washington, D. C.
- Apr. 30-May 11. British Industries Fair. London and Birmingham.
- May 1-3. American Oil Chemists' Society. Roosevelt Hotel, New Orleans.
- May 1-Sept. 30. Festival of Britain, Exhibition of Science. South Kensington, London.

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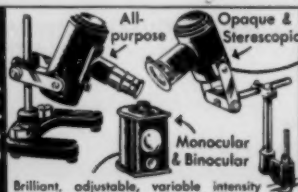
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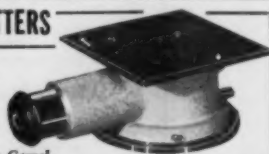
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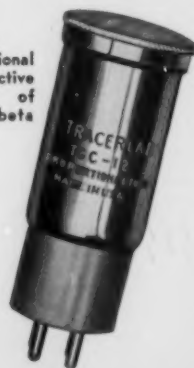


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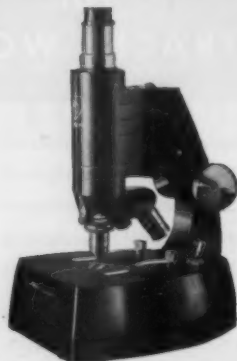
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